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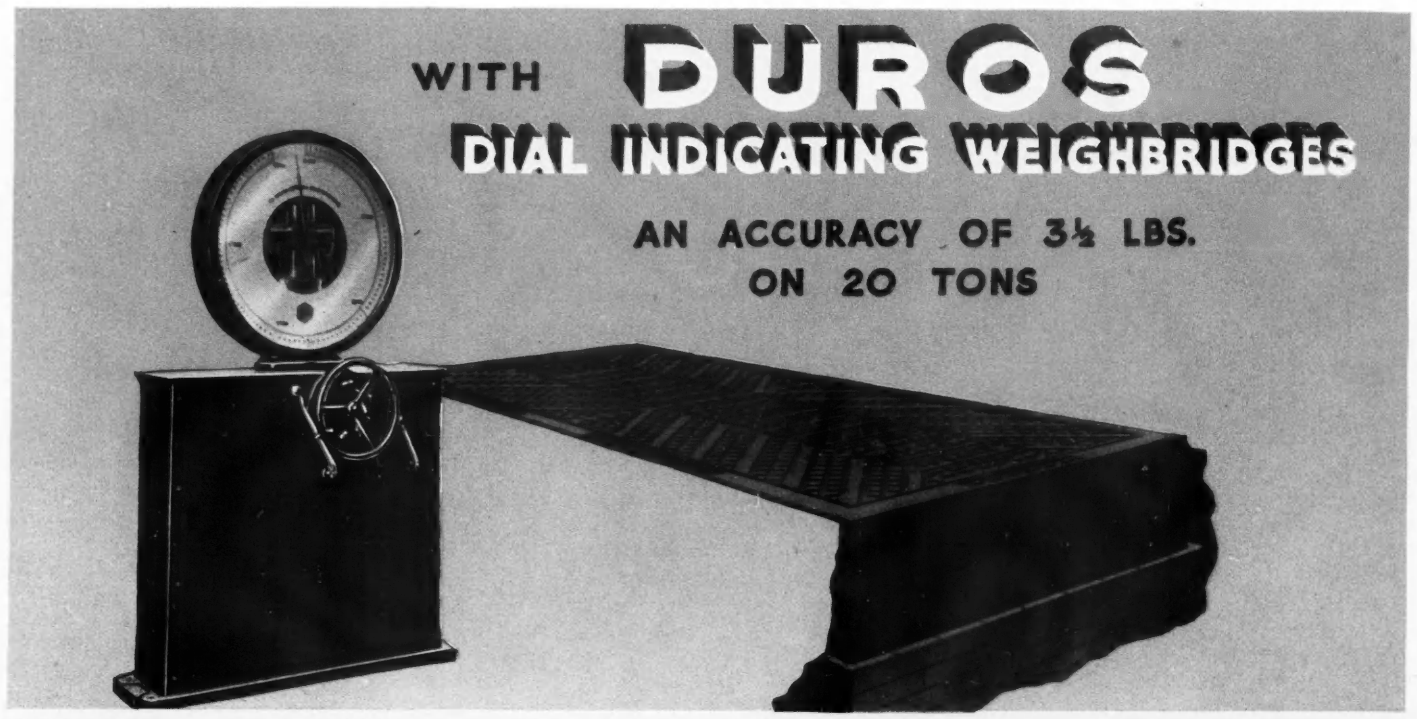

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A Seven-Day Journal

Civil Aviation Progress

An Air Ministry Report which has recently been issued reviews the progress of civil aviation since the war began. On Saturday, September 30th, the first regular experimental air mail service across the Atlantic from Southampton to New York, *viâ* Foynes, Botwood, and Montreal was completed by the arrival of the Imperial Airways' flying boat "Cabot" at its base in this country. The programme which embraced eight journeys each way over a period of eight weeks starting from August 5th has been carried out unostentatiously and without a hitch. Twelve of the sixteen journeys have been ahead of schedule, and on the weekend of the 23rd–24th September, "Cabot" achieved the fastest time so far recorded for the Atlantic crossing from East to West by flying from Foynes to Botwood (Newfoundland) in exactly 13 hours. Altogether 50,000 miles have been flown. In view of the withdrawal, since the war, of meteorological facilities and the restrictions on radio communications both from aircraft and from ships, the successful accomplishment of these flights is a great tribute to the skill of the navigators. Imperial Airways has also recently been operating a flying boat ferry service to connect with the Pan American Airways' Trans-Atlantic service which, since the outbreak of war, has terminated at Foynes on the Shannon. On the Empire Air Routes, two services a week are being maintained to Sydney, one to Kisumu, and one to Durban by flying boats. One service a week is also being operated to Egypt *viâ* Malta, by landplane, and the possibility of extending it to India is under consideration. The overseas feeder services to these trunk lines have also in general been maintained. Continuance of the service would not have been possible without the helpful co-operation of the French authorities in regard to flights over France. In the European zone, it has been necessary to suspend most of the services. A notable exception has been British Airways service once weekly to Stavanger, Stockholm, and Helsinki and back, which was inaugurated only a week before the outbreak of war. The regular services between London and Paris have now been resumed jointly by Imperial Airways, Ltd., and Air France. It may also be possible shortly to run a regular service to Lisbon. For a variety of reasons internal services have suffered a certain amount of dislocation. Services are being maintained, however, on the Renfrew–Islay–Campbeltown route and between the North of Scotland and the Orkneys and the Shetland Islands. It is the intention, subject to defence considerations, to encourage services of this kind which can be shown to serve a useful purpose.

Farringdon Station Train Accident

Colonel A. C. Trench has now reported to the Minister of Transport on the train accident which occurred on Monday, May 1st, on the section of the Metropolitan Railway at Farringdon Street Station. It will be recalled that a three-car electric train was leaving Farringdon Street for King's Cross when it came into collision with a Great Western engine and brake van, approaching on a line crossing the front of the train. The front coach of the train was derailed and damaged and several persons were hurt. Colonel Trench states that the accident was caused by the motorman of the electric train passing the starting signal at danger. He says that the signal D10 must have been displaying a danger aspect when the electric train passed it, and that its train stop was in the "on" position, and was struck by the trip cock, but because of the speed attained in starting from the three-car mark, the brake application caused by the trip cock which probably synchronised with that given by Motorman Pither's release of the dead man's handle, had not sufficient time to stop the train before the collision. While the primary responsibility must be borne by Motorman Pither, a share of the responsibility must be attributed to Guard Walker, as under the regulations the guard is responsible for making certain that the starting signal is off before he gives the starting signal to the motorman. It is possible, Colonel Trench says, that while the motorman's attention was directed to starting his wind-screen wiper, he heard the guard's bell and without thinking accepted it as the other type of bell which would in itself have been an indication that the starting signal was off. It must not be overlooked that the next signal ahead was clearly visible and was at green. The inherent similarity between the two alternative bell signals, one of which proves that the starting signal must be off, and the other only meaning that the train doors are closed, may probably have been a contributing cause in this accident. During the transition period of introducing the newer air door trains, Colonel Trench thinks that the present arrangements may induce a false sense of security, or at any rate a risk of misapprehension. There are various possible schemes, such as that the noise in one case should be a bell, and in the other a hooter, or that the platform bell should be abolished and the illumination of the "S" light should be the motorman's signal from the guard to start the train, as in the case of the older trains.

The Loss of H.M.S. "Royal Oak"

On the morning of Saturday, October 14th, it was announced by the Admiralty that one of our 29,000 ton battleships, H.M.S. "Royal Oak," had been sunk. The sinking it was stated was believed to have been caused by German submarine action. Out of a total complement of about 1200 officers and men, the total number of survivors, according to the latest Admiralty lists, is 414, and it is further stated that the possibility of there being further survivors must now be regarded as remote. The "Royal Oak" was one of five vessels of the "Royal Sovereign" flagship class, and was laid down in Devonport Dockyard in January, 1914. She was completed in May, 1916, and had an overall length of 620ft. 6in., a beam of 102ft. 6in., and a mean draught of 28ft. 6in., with a displacement of about 29,150 tons. Her machinery was supplied by R. and W. Hawthorn Leslie and Co., Ltd., and comprised direct-drive main turbines and geared turbines for cruising purposes, steam being taken from oil-fired Yarrow boilers. The designed speed of the "Royal Oak" was about 23 knots, but this was reduced to about 22 knots when at a later date protective bulges were added. The armament comprised eight 15in. guns, twelve 6in. guns, eight 4in. anti-aircraft guns, besides smaller guns and four submerged torpedo tubes. One aircraft launched by a catapult was carried. The "Royal Oak" was in action at the battle of Jutland and was also under fire during the Spanish civil war. In March, 1934, she was withdrawn from the First Battle Squadron, and was transferred to Dockyard control for extensive reconditioning and repairs, which were completed in 1936 at a cost of about £1,000,000. During this period of refit, the "Royal Oak" was provided with protective bulges, and on her completion her defence against under-water attack was considered to be very strong. The latest official information is to the effect that the "Royal Oak" was torpedoed at 1.30 a.m. while at anchor at Scapa Flow by a submarine which had penetrated our defences. She was struck by one torpedo and then after an interval by three more.

The Control of Machine Tools

The Control of Machine Tools (No. 1) Order, 1939, which has been made by the Minister of Supply under Regulation 55 of the Defence Regulations, has now been published by the Stationery Office. It provides that every person engaged in the production, keeping, distribution, disposal, acquisition, or use of machine tools situated in the United Kingdom, shall comply with any directions or instructions issued or given by the Ministry of Supply, with regard to the manufacture, use, and disposal of such tools. For the purpose of the Order the expression "machine tools" includes any mechanical contrivance for cutting, forming, abrading, polishing, or otherwise working wood or metal, and any accessory small tool or equipment used for these purposes. The Order came into operation on Friday, October 6th. The provisions of the Order also relate to the use of drawings, patents, trade processes, and designs used in connection with the production or use of machine tools, and to sub-contracting work. The Minister of Supply under this order requires that books, accounts, and records shall be kept, and shall be available for the inspection of an examiner or inspector appointed by the Ministry, who may require estimates and returns and may inspect premises. The powers may be delegated by the Minister of Supply to such person or persons as the Minister may think fit.

A Ministry of Shipping

On Saturday, October 14th, it was officially announced that Sir John Gilmour, a former Secretary for Scotland and Home Secretary 1932–1935, had been appointed Minister of Shipping. The formation of a Ministry of Shipping with the object of co-ordinating the work of the Mercantile Fleet was referred to by Mr. Chamberlain in the House of Commons on September 13th. On October 16th, it was announced by Sir John Gilmour, that in the organisation of the new Ministry, it is his intention to make the fullest use of the services of shipping men, some of whom are already at work in the new department. With the approval of the Prime Minister, Sir John has made certain appointments. Sir F. Vernon Thomson, the chairman of the Union Castle Line and the King Line, as well as other companies, who was associated with the former Ministry of Shipping, has agreed to act as Principal Shipping Adviser and Controller of Commercial Shipping. Sir Cyril Hurcomb, who was Deputy-Director and later Director of Commercial Services in the former Ministry of Shipping and has been Permanent Secretary of the Ministry of Transport, and the Chairman of the Electricity Commissioners since 1938, will act as Director-General of the new Ministry. The Secretary will be Sir E. Julian Foley, who, since 1939, has been Under-Secretary in charge of the Mercantile Marine Department of the Board of Trade. During the last war Sir Julian served in the Transport Department of the Admiralty and was Director of Military Sea Transport in the former Ministry of Shipping. He has maintained contacts with the Admiralty and the Board of Trade for over thirty years, in connection with all matters relating to ships and shipping, and alongside his administrative duties has always shown concern for the safety and welfare of those who in any capacity follow the sea. Sir Julian had a great deal to do with the Government plans for the revival of tramp shipping and the replacement of tramp tonnage under the "Scrap and Build" scheme. In accordance with plans prepared before the outbreak of war, the Mercantile Marine Department of the Board of Trade will be merged in the Ministry of Shipping.

The Metropolitan Water Board

It is announced that the Metropolitan Water Board which, at the outbreak of war, had under construction three new reservoirs, at Chingford, Staines, and Walton, has decided to terminate the contract for the Walton reservoir. Correspondence has passed between the Board and the Minister of Supply with regard to the work of excavation which is now being carried on at the Chingford and Staines reservoirs. In reply to the notice of the Minister that he intended to exercise his compulsory powers with a view to utilising on work of national importance a considerable portion of the excavating plant, the Board made strong representations to the Ministry urging the imperative need for the completion of both the Chingford and the Staines reservoirs as soon as possible. If it was necessary to withdraw some of the excavating plant, such withdrawal, the Board suggested, should be confined to the plant at Staines so that the more vital work at Chingford could proceed. In his reply the Minister indicated that in view of the urgency of the Government work, it was essential that the excavating plant in question should at once be placed at the disposal of the Government. Under the Defence Regulations, the Minister has now requisitioned the excavating and earth-moving plant together with other machinery and equipment, and has directed that it shall be placed at the disposal of the contractor, to be used as the Minister may direct. It is stated by the Ministry that the plant will be moved as and when required for use elsewhere, and that the operations at the reservoirs will be interfered with as little as possible. The Board has appointed Mr. H. F. Cronin, M. Inst. C.E., to the position of chief engineer to the Board. It may be recalled that Mr. Cronin was appointed acting chief engineer on the retirement of Mr. Stilgoe, and served for six months until Colonel Davidson took up his duties. Mr. Cronin has acted in the same capacity since Colonel Davidson resigned in May last. Mr. W. G. P. Thorold, M. Inst. C.E., has been appointed deputy chief engineer to the Board.

Diesel Engine Users Association

The opening of the 1939 session of the Diesel Engine Users Association took place at Caxton Hall, Westminster, London, S.W.1, on Thursday afternoon, October 12th. The President, Mr. George E. Windeler, M.I. Mech. E., announced that the Committee of the Association had decided to continue the meetings at a somewhat earlier hour—2.30 p.m.—and to submit for discussion a series of papers which would carry out the object of the Association, that of providing useful information with regard to the design and running of oil engines. A symposium on the running gear of oil engines was then presented and discussed. Twelve of the leading British builders submitted short accounts of their recent developments which, in many cases, were illustrated by drawings. Mr. Windeler, in introducing the subject, said that he welcomed these contributions as showing that British firms were not afraid of publishing and discussing details of design and construction. A good discussion followed, and the President effectively dealt with all the questions which were raised. We were surprised to note that none of those who had contributed to the symposium were able to be present to defend their views and reply to questions which were raised, and out of all the oil engine building firms only two were represented. It is to be hoped that in spite of the difficult times and limited travel facilities, builders, consulting engineers, and users of oil engines will take the advantage of meeting together on these occasions.

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Scottish Locomotive Experiences

By E. H. LIVESAY

No. V.—L.M.S.R. GLASGOW-INVERNESS TRAINS: "5XP" AND "5P" CLASS ENGINES

(*Continued from page 344, Oct. 6th*)

THERE are not many railway routes in Scotland with easy gradients, the rugged nature of most of the country making this very difficult for the civil engineer to achieve. The existing few are in the southern area, into which location the Glasgow–Inverness line does not come. It runs up into the Highlands, and the farther north it penetrates the more severe and frequent the gradients become. The distance from Glasgow to Inverness is 181 miles, and on leaving Buchanan Street Station, a very heavy 3·5-mile incline to Robroyston has to be mounted, with gradients of 1 in 79, 98, and 120, after which things are comparatively easy to Cornton Siding, 2 miles beyond Stirling, and 31·5 miles from Glasgow; 15 miles of rising gradients then follow to near Gleneagles, the first 6 to Kinbuck being heavy. From Gleneagles it is mostly downward to Perth, 63 miles from Glasgow, where the really heavy climbing begins, the stiffest I came across in Scotland, even worse than on the Mallaig line. Inclination is equally severe, and there is far more of it. First come 13 miles of climbing to Kingswood Crossing, the culmination being at 1 in 82 and 76; then after 2 miles at 1 in 80 down and 9 miles of easy going, comes the very severe 29-mile ascent over the Grampians, beginning at Ballinluig, to Drumochter, 1484ft. above sea level, between Dalnaspidal and Dalwhinnie, three-quarters of it ranging from 1 in 75 to 1 in 100. Over the top, the highest point on a main line in Britain, there follows a 19-mile drop to Kingussie, the ensuing 11 miles of easier going being succeeded by 12 miles of renewed climbing to Slochd Summit, 1315ft., some as severe as 1 in 60. After this there is a steep 21·5-mile fall into Inverness, much of it being again at 1 in 60. The route is no exception to the rule that where you find heavy gradients frequent curvature is almost certain to accompany them. It is a very difficult piece of road indeed, and makes a corresponding call on engine power. There is no necessity to draw attention to the scenery, beyond saying that, beginning with the soft and homely lowlands, it gets ever more severe the farther north one goes, until the wildest and most inspiring Highland mountain country is ultimately reached. Scenes of beauty and objects of historic interest are to be found on all sides, and the enginemen never let any of them go by without pointing them out to me. I could not help being struck by the intimate acquaintance most of the Scotch crews seemed to have with their country and its story, and their pride in it. It made me ashamed of the comparative abysmal ignorance of my native land I display when going through it.

The most important of the Glasgow–Inverness services are carried out by the "5XP" and "5P" class engines, the former being kept on the easier section south of Perth. Both are of the 4–6–0 type, the former being built for express work, with three cylinders, and the latter for mixed traffic with two. Many details and fittings are common to both classes, standardisation being responsible for this. The chief dimensions of the two classes are given below:

	"5XP" class.	"5P" class.
Cylinders	(3) 17in. × 26in.	(2) 18½in. × 28in.
Driving wheels ...	6ft. 9in.	6ft.
*Heating surface:		
Fire-box, sq. ft.	181	171·3
Tubes, sq. ft. ...	1,460	1,478·7
Superheater, sq. ft.	307	359·3
Total, sq. ft. ...	1,948	2,009·3
Grate area, sq. ft.	31	28·65
Boiler pressure, lb.	225	225
Tractive effort, lb.	26,610	25,455
Weight:		
On coupled wheels, tons	60	53·15
Engine, tons ...	79·55	70·6
Engine and tender, tons ...	133·20	125·25
Coal, tons	9	9
Water, gallons...	4,000	4,000

* Large numbers have these dimensions: Fire-box, 162 sq. ft.; tubes, 1,568 sq. ft.; Superheater, 330 sq. ft.; total, 2,060 sq. ft.

The boilers are of taper form, and the fire-boxes Belpaire; earlier engines had no domes, and smoke-box regulators. Top feed is arranged, and later engines have the regulators in the dome, the feed being delivered just forward of it. Originally, the superheater was small, only raising the temperature of the steam to a moderate extent, this system having been adopted by the late Mr. Churchward, and it has remained a feature of G.W.R. locomotives ever since. It would seem that whatever could have been advanced in favour of the low superheat theory then, it has not been accepted as fundamentally desirable, or adhered to by the generality of locomotive engineers since. Its chief "talking point"—in fact, the only one of any importance that the writer has ever heard advocated—is that no more than sufficient superheat need be given to the steam to prevent condensation, any over and above that being thrown to waste in the exhaust. As our Transatlantic cousins would say, "So what?" It is one of those theories in which my doubtless limited mental powers have never been able to see much point. Surely the lower the superheat the more steam that must be used to do a given amount of work? Therefore steam is being wasted. Is it preferable to waste steam or superheat—which costs most? Probably the former, and as the vast majority of locomotive designers seem to be of the same opinion, at any rate the writer is in good company. But perhaps I am flogging a dead horse, as the low superheat principle is no longer a feature of L.M.S. engines.

The 6ft. driving wheels of the "5P" class are well suited to the severe Highland gradients, though they are large enough for high speeds on occasion. The 28in. stroke is another good feature where much hillclimbing is involved. On the G.W.R. 30in. stroke has been adopted for mixed traffic engines, in combination with small wheels, and I am reminded of the "mixed traffic" 2–10–4 C.P.R. engine on which I came through the Rockies, with 5ft. 3in. wheels and 32in. stroke. A long leverage is advantageous under these conditions.

The "5XP" class has divided drive, the inside cylinder being placed well forward, driving the first coupled axle, the outside pair the second one, the cranks being at 120 deg. Separate Walschaerts valve gear is provided for each cylinder. The L.N.E.R. three-cylinder engines have only two sets of valve gear, the inside valve being driven by conjugated levers from the other two. With individual sets there can be no dispute as to whether the inside cylinder is doing its share of the work and no more; it has been stated, with what truth I do not know, that with the conjugated system the steam distribution in the inside cylinder is affected. It would be an interesting discussion—if carried on by people who know what they are talking about, which in this case would not include the writer—to try and decide what are the definite good and bad points of the two arrangements, and whether the conjugated system really is better than the other. Does it score on the side of simplicity or do the levers, guides, links, and pins, to say nothing of two additional glands, when the gear is in front of the cylinders, total up to as much mechanism as would be needed for a separate set of valve gear? It cannot be claimed that there is not room enough between the frames for the single set of gear without cramping. I have been underneath both L.M.S. and Southern Railway three-cylinder engines; there is no lack of space with either. Why should there be? In the old days they thought nothing of putting two sets of motion and two sets of valve gear—each with two excentrics, four in all, whereas a single set of Walschaerts gear only has one—between the frames, and it would seem that "things went very well then." So why this modern objection to one set of motion and one excentric in that position? It hardly seems logical. It must be admitted that probably the two extra glands are not a very vital matter, as they are not likely to give trouble with inside admission, being only acted on by the low-pressure exhaust steam. Are the inertia forces at high speed caused by the weight of the conjugated levers adding to wear and tear on the other sets of valve gear worth considering or not? A good deal can be said *pro* and *con* these two conflicting valve-actuating theories; one thing, at any rate, is certain, and that is that individual sets of gear work perfectly well, both the L.M.S. and Southern Railways preferring that arrangement.

But we shall never get to Inverness unless I disentangle myself from the valve gear.

The three-cylinder 120 deg. drive has a very good feature, in that it gives six exhaust beats per revolution, with the result that the draught on the fire is steadier, and smoke-box vacuum does not fluctuate so much as with two cylinders, or similarly with four, if the 90 deg. drive is adopted. The best plan of all, from the draught-inducing point of view, is the 90 deg., 45 deg., 90 deg., 135 deg. crank spacing method, which I mentioned as having found on the Southern "Lord Rodney" (The Engineer, April 28th). This gives eight beats per revolution, practically a continuous draught.

The three-cylinder system makes for a steady-running engine, the balance as a whole being good. With the divided drive, however, the balance of each individual driven axle is no better than it would be in the case of a single-cylinder engine as regards the first axle, and a two-cylinder engine with the second—the hammer-blow is not very much affected by the three cylinders, except in so far as it is spread over two axles instead of one, and by the lighter reciprocating parts. In this it is different from the L.N.E.R. lay-out, wherein all three connecting-rods generally drive the middle axle; in that case they all affect each other directly.

Both arrangements have their advantages, and another interesting discussion could be had on the subject. I confess I like the three-cylinder system, and in spite of the fact that a certain four-cylinder class stands first in my regard, out of all the many different types and designs of which I have had experience lately, I prefer the triple to the quadruple, if only because I never can see the necessity for the fourth cylinder. If three can do the work comfortably, as obviously they can, why use four? In England, with big engines, am I correct in saying that two cylinders are an impossibility three a necessity, and four a luxury? Raise the steam pressure to 300 lb. and two outside cylinders could still be used; but then up comes the bugbear, hammer blow. However, I had better cease theorising and come to practice, as exemplified by the "5XP" class engine, on which I travelled out of Glasgow with the 10.6 a.m. train to Inverness.

This was "No. 5728," "Defiance," Driver Walker and Fireman Murray, the load being nearly 400 tons gross, and the weather fine. The start was made with full regulator and 55 per cent. cut-off, with which the very steep 3·5-mile incline, mostly 1 in 79–120, to Robroyston was begun; it was shortened to 25 per cent. before the station was passed. After Robroyston it is approximately level going to Gartcosh, 7·5 miles, passed at 50 m.p.h. in fifteen minutes. Leaving Gartcosh, the line begins to see-saw up and down, but chiefly the latter, and after slowing for a permanent way restriction at Greenhill we passed Larbert at 10.36 a.m., where there was a speed restriction, and another 15 m.p.h. slowing due to pit subsidence at Bannockburn. This place was run through at 10.43 a.m., and the Stirling stop made at 10.45 a.m., one minute late, due to the slowings. Thirty miles in 39 min., 46 m.p.h., good work with a 400-ton train. Water was taken here and the re-start made at 10.48 a.m.

I have mentioned the care which the Scottish crews took to point out to me anything of interest passed; the Wallace monument was the first instance of it on this run. It stands majestically on a hill just outside Stirling, in a splendid setting. At Cornton siding, 2 miles beyond Stirling, the severe Dunblane bank begins, nearly 6 miles long, through Bridge of Allan, to Kinbuck. It was taken with 40 per cent. cut-off and full regulator, the speed being about 35 m.p.h.; the summit, at Kinbuck, was passed at 11.01 a.m., and here we ran into showers. The gradient then levels out and the speed began to increase, reaching 55 m.p.h. at Greenloaning, on a slight rise, and 65 at the foot of the Blackford bank. Just over the top of this, at the beginning of a long drop nearly to Perth, we came to a stop at Gleneagles, 11.12 a.m., 47 miles in 66 min., average speed 43 m.p.h. I find a note here, *apropos* of what, I do not remember: "Driving wheel tires a little hollow; want a touch up; no slipping." Down the incline from Gleneagles the speed rose to 65 m.p.h., with the regulator nearly shut, the cut-off remaining at 25–35 per cent., the rule on these engines when drifting. The weather gave one of its quick-change acts here; the rain ceased, and out came the sun, to show up the primroses speckling the banks and cuttings, which I noticed as we ran down through Dunning at 70 m.p.h., to a standstill in Perth, 63 miles from Glasgow, at 11.29 a.m., two minutes late, the average speed having been

45·5 m.p.h. Here "No. 5728" came off, its place being taken by a two-cylinder "5 P" class engine.

Perth is a very large and important station, the meeting point of several lines, and is jointly owned by the L.M.S. and L.N.E. railways. Lengthy station work held the train there until 11.52 a.m., when a restart was made with a 360-ton load, 7 min. late, the engine being "No. 5459," "5 P" class, in charge of Driver Geddes and Fireman Chapman. It is always easy to detect the different action of three and two-cylinder machines, and this engine change gave an instance of it. The get-away was good, on 40 per cent. cut-off and full regulator, but the harsher operation of the twin cylinders was evident at once. The gradient soon began to stiffen, and at Strathord, on 1 in 125, 5 miles from the start, the speed had only reached 35 m.p.h., and the cut-off was still 40 per cent. Stanley, the first stop, 7 miles in 12 min., was on an up gradient, and the restart called for 70 per cent. cut-off. Single track begins here, the Manson tablet-exchange apparatus, described in the last article, being used. Up 1 in 82 to the "peak" at Kingswood crossing loop, the cut-off was 45 per cent., the speed falling to 15 m.p.h., the summit time being 12.22 p.m., 13 miles in 30 min., with heavy going and two stops.

A trip through the Highlands is very fascinating, for other than merely locomotive reasons; there is so much to see, and the crews never let me miss anything. Birnam Wood was pointed out, but I had no time to decide whether any of it had actually moved to Dunsinane, as by this time we were over the top, running fast downhill towards Dunkeld, and the footplate interested me more than Macbeth. A hailstorm made exterior observation difficult, too. Dunkeld was reached at 12.24½, so we had made about 60 m.p.h. over the 2½ descending miles from Kingswood. The riding at speed was good, but it emphatically did not come up to L.N.E.R. "V 2," "No. 4793" standards. Alas! I fear nothing ever will! Soft-running engines are few and far between—it only remains for me again to get used to something hard.

It is easy going from Dunkeld to Ballinluig, which is at the foot of the long, severe climb to Drumochter summit, which the crew called "The Hill," 1484ft. The station was left punctually at 12.30 p.m., in another hailstorm, with heavy rain, in spite of which there was no slipping. The up gradient is not quite continuous; there are a couple of short drops, and the real pull does not begin until Killiecrankie is reached, after we had halted at Pitlochry, a few minutes late. There is a 1 in 82 stretch immediately out of Pitlochry, which called for a cut-off of 45 per cent. Shortly after, the Pass of Killiecrankie was entered. The scenery is wonderfully picturesque here, with the Tay meandering alongside the railway, yet all harshness is taken out of it by trees and greenery on the river banks. I am afraid my attention wandered outside the cab a good deal along this stretch; the point of cut-off took its rightful place in the scheme of things, and did not seem so vitally important after all. Other things claimed some consideration too, such as the battlefield of Killiecrankie, near the station. I do not know who fought here or why; I am rotten at Scottish history, and I was afraid to ask the crew for fear I should put my foot in it someway, and get thrown off the footplate! Double track begins at Blair Atholl, the next stop; the River Garry clings to the railway, first on one side, then on the other. At this point I regret to say we were 11 min. late. But the gradient had been heavy, and was going to get much worse, so water was taken and a bank engine came on in front. It was no longer in its first youth, but looked just the kind of machine for occasional banking duties, its tractive power being considerable. It was a 4–4–0, "No. 14,379," named—I am sorry, but I do not understand Gaelic, or, in this case, even my own writing, complicated as it is in my notebook by oily finger-prints. I changed over to it, as it appeared an interesting veteran, of a class I was not likely to encounter again, and it got away vigorously, the old warrior putting her best leg foremost—if the metaphor may be excused—with half regulator and 50 per cent. cut-off. The cab was of the cut-away type, and it seemed as though the cutting had been overdone and not quite enough left. We ran into yet another hailstorm, the wind was blowing great guns, apparently from every direction at once, and no place in the cab was safe from it. When it arrived from over the tender it brought a cloud of coal dust with it, and presented it to me, though I had far rather have been without it. I cowered into the corner of the cab, up against the warm fire-box, but the gale sought me out—and found me. I looked regretfully back at "No. 5459," roaring away behind, and thought of the comfortable cab I had so recklessly left, comparing it with the bleak austerity of the cave of the winds I was in, wondering why I had been so foolish as deliberately to exchange luxury for poverty, when there had been no necessity to do so. But there I was, and there I had to stay awhile, to put down on the fluttering pages of the pad what notes my numbed fingers would permit.

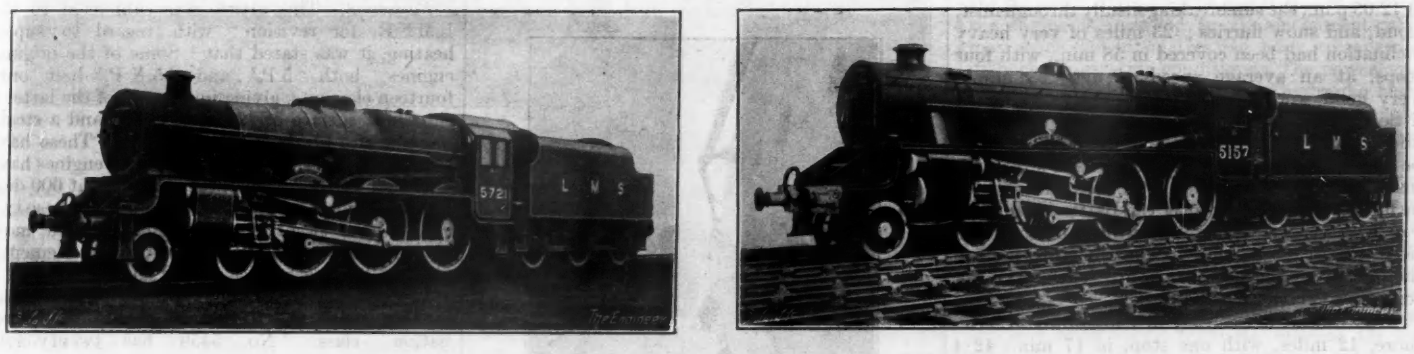
The riding of "No. 14,379" was surprisingly good. I have marked it as "very good," and that, as I said in my last article, means just what it says. Curves were numerous and sharp, yet they were taken quite casually, with no objection; I have been on modern engines to which this oldster could concede many points for tractability. The look ahead was the best I have ever enjoyed, and as the cab was high and the boiler low I could see right across it from either window—I mean I should have been able to do so if they had had wipers. The driving rain and hail clouded them, not the exhaust; both engines were working hard, and "No. 14,379" was doing her full share, with the result that the steam passed high over the roof. A 1 in 70 gradient extends with few interruptions for 10 miles nearly to the Drumochter summit, after a stop at Struan, where I was strongly tempted to get off and rejoin "No. 5459," though I had only been a quarter of an hour in that wind tunnel. But my courage failed me. What would these hardy Highlandmen think of the Sassenach who could not stand a little wind? So I went on, pretending to be happy, though I knew that after Struan there would be no stop for half an hour until Dalnaspidal was reached. It seemed a long half-hour, one of the longest I have ever spent on a footplate. Still, it was very interesting, as it covered the culminating 18 miles climbing, chiefly around 1 in 70, during which the locomotive team had to extend itself as the engines worked their way, on generous regulator and cut-off, at 15–20 m.p.h. to the peak. Incredible though it may sound, before we reached it I found myself getting quite fond of the old harridan, who, though near the sere and yellow leaf, was still capable of such hard and willing work. But at Dalnaspidal, not quite the summit, I tore myself away and went back to "No. 5459," which from here took the train on alone to the top. The last 2 miles are mostly at 1 in 78, and were taken on a cut-off of 45 per cent. Nearing the peak the country became more and more stern and forbidding, opening out considerably, the hills receding from the track, crouching in the background, windswept and bare. The hail and rain had turned to snow, and the prevailing grey-toned landscape was becoming white; the highest point was reached and passed at 1.50 p.m. The 29 very trying miles from Ballinluig, with five stops, and the heaviest gradients had been covered in 80 min. I was told that Druimuachdar, the Gaelic name, means "the highest ridge"; once over it we began running down a 19-mile descent to Kingussie, past Ben Alder, raising its snow-covered peak to 3757ft., and Loch Ericht; a stop was made at Kingussie at 2.18 and water taken. We had left Drumochter's snow and cloud mist behind, coming down into sunshine under blue skies, which did not prove lasting.

Over this route to Inverness speed is not really limited, but when passing stations, where tablets are exchanged, it is reduced to 40 m.p.h. Good time was made over the easy stretch to Aviemore, where arrival was at 2.41 p.m., 8 min. late; here the engine came off, its place being taken by another of the same class—"No. 5016," Driver McLachlan and Fireman McKenzie. The 30 miles down from Drumochter, with four intermediate stops, had been covered at an average speed of 35 m.p.h.

Aviemore lies at the foot of another great bank, 12 miles long, to Slochd summit, 1315ft., with gradients as severe as 1 in 60. It was left to time, and once more the train began climbing up into the rain clouds, against a head wind, to where snow was lying and still falling. The cut-off lengthened to 40 per cent., and the speed fell as low as 15 m.p.h. This open country was a good place to turn on the soot blower, which is a standard fitting on L.M.S. locomotives, and it was done. It is used about every 100 miles; a valuable device of which the crews always speak well. "No. 5016" was due for a shopping, one indication being a knock on the left side. The summit was passed at 3.11 p.m., making the average speed up the heavy 12-mile pull, with one stop, 29 m.p.h., really good work for a single engine. The outlook at Slochd is as wild as that at Drumochter, and though it was the end of April, snow-covered mountains were to be seen on both sides of the track, the most majestic being Ben Wyvis, 3400ft. It was all very British Columbian on a smaller scale, and Craigellachie Rock was another reminder. I recalled passing Craigellachie in the Selkirks on another footplate; it was there that the last spike was driven by Donald Smith, Lord Strathcona, linking the eastern and western construction of the C.P.R., and completing the steel highway from Atlantic to Pacific.

Leaving Slochd a steep 23-mile descent into Inverness begins, with 1 in 60 gradients, through Culloden, where the scene of Prince Charlie's defeat can be picked out on the left. The engine was drifting practically all the way down, and it is the rule that under these conditions cut-off should be 35 per cent., with the regulator only open just enough for cushioning purposes. Had this not been carried out, no doubt the play in the motion I mentioned would have been even more noticeable. Inverness was reached at 3.44 p.m. The train runs past on a side line, and then backs into the station, the final stop at the platform being made right on time at 3.46 p.m. The 23 miles down from Slochd, with four stops, had been covered in 33 min., at 42 m.p.h. It had been a most interesting journey, over an exceedingly heavy route, increasing my understanding of, and respect for, Scottish locomotive work and enginemen, already high.

There are many interesting things to be seen in an engine shed by anyone labouring under a locomotive complex, and the one at Inverness is no exception. Space, unfortunately, will not permit me to demonstrate it. I met with the same courtesy and goodwill that have invariably been my lot, once the officials realise I am merely fond



L.M.S. 5XP CLASS "IMPREGNABLE" AND 5P CLASS "GLASGOW HIGHLANDER" ENGINES

of locomotives, and am otherwise quite harmless. I will mention one little thing I noticed, which added another proof to the many I have chanced upon that show Scotsmen can generally both see and make a joke. It is only the skulls of individuals that are as the nether millstone. In the shed there was a locomotive boiler, kept permanently in steam, used to provide hot water for washing out, and fuel for such purposes as burning the carbon out of blast-pipes, &c. It had been affectionately christened "Black Bess," but someone, either in anger or in derision, had substituted an M for the second B. I hope no reader from North of the Tweed will write for an explanation of this, or my whole thesis will be ruined. On second thoughts, I see it will not—it will be confirmed.

The following day I left Inverness on the 11.5 a.m. train. The engine was "No. 5175," "5 P" class, Driver Fraser and Fireman Kennedy, and the load 260 tons gross. One mile south, the gradient begins, at 1 in 60–70, ending at Culloden Moor. It was taken with full regulator and 40 per cent. cut-off. As had happened more than once the day before, the train climbed up into rain and snow. The Culloden stop was made at 11.23 a.m., 6·5 miles of steep incline having taken 18 min., 21·7 m.p.h. Once away from Culloden, over the great 29-arch viaduct, another climb begins, of 1 in 60, for 6 miles; this called for 50 per cent. cut-off, and brought the speed down to 20 m.p.h. The weather, which had been dull but dry at Inverness, deteriorated on the way up, and at Daviot we ran into a sprinkle of snow. From a point 2 miles beyond Daviot, the going is easier; then at Tomatin, the 1 in 60 gradient begins again, and continues at this figure to Slochd summit, the climb being taken on 40–50 per cent. cut-off, the speed being 15–20 m.p.h. The peak was passed at 12.03 p.m., the sun breaking fitfully through mist, cloud, and snow flurries; 23 miles of very heavy inclination had been covered in 58 min., with four stops, at an average speed of over 23 m.p.h. Very good work, during which the fireman had little chance to look at the scenery. Nevertheless, he did point out to me all the objects of interest to be seen on the way up. Prince Charlie's tree, for instance, close to the track; the tree under which he had rested during or after the Battle of Culloden—I forget which—and round which the road had been made, so as not to destroy this natural monument to the national hero. They have not forgotten Prince Charlie up there!

After Slochd it was easy drifting down to Aviemore, 12 miles, with one stop, in 17 min., 42·4 m.p.h. *Facilis descensus ad Aviemorum*—which shows that Latin and locomotives can at any rate run downhill in double harness.

At Aviemore engines changed, "No. 5461," another of the "5 P" class, coming on with Driver McIntosh and Fireman McKay, the train, 300 tons gross, leaving punctually at 12.33 p.m. The following 12 miles are quite easy, and carried us to Kingussie, at the foot of the long climb up to Drumochter summit, which was passed at 1.37 p.m., the 19 miles of collar work, with two stops, having taken 43 min., 26·5 m.p.h. Again we had run into snow, the clouds rolled over the mountains and swirled round us. It must be fascinating to take a trip over this line in winter, when the snow is deep, and the isolated cottages lie half-buried in drifts. I can imagine it on a fine day, the great expanse of moor, rock, and torrent, a silvery white waste glittering in the sunshine under a blue sky—a miniature British Columbia. If I ever feel too strong a longing for the Rockies and the Selkirks in winter—a few weeks of London murk have induced this occasionally—and I cannot go to them, I think I shall come up to Drumochter to get rid of the nostalgia. Snow ploughs and drift fences must have plenty to do in the Slochd and Drumochter country.

Over the top the engine can practically drift down to Killiecrankie, 21 miles, except for stops at Struan and Blair Atholl. It is wild country; I saw deer silhouetted against the skyline, just as I had done on the West Highland run—the district is very similar. After Killiecrankie and a brief upward pitch, it is steeply down through Pitlochry, to a stop at Ballinluig, 2.30 p.m., exactly to time, the 29 miles from Drumochter having been covered at an average speed of 33 m.p.h. with four stops. We had run down out of the bleak, snowy Grampians, into the warm, sunny beauty in the valley of the Garry, looking so soothing and homely after the harshness of the wilderness left behind. Coming down, I had noticed what unusually large windows the L.M.S.R. "5 Ps" have, and how good the look ahead is as a result, so, running out of Pitlochry, I took a photograph through the one on the fireman's side, to have a permanent record of this. It is seen below. A view taken at "eye level" would be better still, as it would be higher up and wider. The mechanical lubricators seen in the picture can be watched in operation through the windows. Another good feature noted in the cab was the divided sliding fire-doors, worked by a large lever. Not only were they easy to operate, but they prevent excessive heat rays striking anyone standing at the side of the cab. I have noticed some very primitive fire-door arrangements in England, but this L.M.S. one is far better, and is much like that used on American hand-fired engines, apart from the pneumatic treadle-operated door, which I think would be such a boon in this country.

This 11.5 a.m. train from Inverness had been right on time, or ahead, all through, gradients and stops notwithstanding, and so it continued all the way into Perth, reached at 3.5 p.m., 5 min. early. There was a wait of half an hour here; the crews changed, but not the engine, and we got away at 3.34 p.m., punctually, with Driver Smith and Fireman McKeith in charge. At the foot of the rise of Gleneagles, while 20 per cent. cut-off and full regulator were being used, the soot blower was brought into operation; it is best, of course, to use it under these conditions. The exhaust took on a perceptibly darker tinge when it was turned on. It is a most useful device, but must not be used too often, as its cutting effect can do harm. I referred in one article to the evidence of personal idiosyncrasies in locomotive design—here is an instance of it. The sand gun or soot blower is clearly a good thing, and has been adopted as a standard fitting on the L.M.S.R., yet none of the other companies utilise it, in my

VIEW FROM 5 P CLASS CAB

recollection. Why not? If it has proved worth while with one company—and it must have done so, or it would not have been adopted—why do not the other companies take it up? Another instance, the steam chest gauge standard on modern L.N.E.R. engines, yet not used by any of the other companies, unless my memory has played me a trick. The Rugby testing plant should do a great deal to standardise improvements in fittings and in design. It will then be possible to prove what things are definitely advantageous, and what are not worth having or are merely luxuries.

The 1 in 100 rise to Gleneagles was taken with full regulator and 35 per cent. cut-off; past the peak and on the slight descent through Greenloaning, the speed rose to 70 m.p.h., and occasionally called for a touch of the brake round curves. Stirling, after a stop at Bridge of Allan, was reached at 4.21 p.m. From there, over a pit slowing at Bannockburn, the going became heavier on generally rising gradients to Cumbernauld, but the speed was kept at a consistently high average, through many junctions, into Glasgow. Buchanan Street Station was reached at 5.07, 2 min. ahead of time, the 29·5 miles from Stirling having been covered, with a stop at Larbert, in 42 min., at an average of 42 m.p.h.

My impressions of the "5 X P" and "5 P" were certainly very favourable. They are most capable machines, well suited to the heavy route over which they are employed, and the crews speak well of them. The working of the three-cylinder "5 X P" engine was, naturally, less obtrusive than that of the two-cylinder "5 P" engines, on which most of my journey was covered, but this was to be expected, not merely because of the more even torque and better balance of the multi-cylinders, but as a result of the 9in. larger diameter wheels. Locomotives with small driving wheels, where front end arrangements are good, are undoubtedly capable of reaching very high speeds, which was proved in America long years before the same thing was done in England, large steam pipes and ports, and ample boiler power having been the rule over there when these assets were generally conspicuous by their absence in this country. Nowadays things are better; small-wheel engines in Great Britain have had their restricting curbs and check reins removed, and are now equally free to extend themselves. Yet the fundamental rule still holds good—large wheels are better suited to high-speed work. The smaller the wheel the harder the engine is on itself when travelling fast, the greater the wear and tear, and the more frequent the shopping. This was found out in the earliest days of the locomotive, a century ago, and it is still true to-day, as it was then. Until the present basic locomotive designs make way for light, high-speed multi-cylinder power plants, with gear drive, I think the rule will still apply. An engine with 5ft. 9in. or 6ft. wheels can, no doubt, reach 90 m.p.h., just as one with 6ft. 8in. wheels can do 125 m.p.h.—downhill; if it were done on the level I should think more of it!—but neither type is really suitable for such velocities, and would soon go to pieces if called on to reach them very often. One has only to travel on a small-wheel engine at speed, feel the threshing, and hear the racket, to realise the truth of this. No machinery, at any rate reciprocating, ever has a long life if extended to its limit, and a six-coupled engine with small wheels, making over 400 r.p.m., is being so extended. As Patrick Stirling once said "It's like a laddie runnin' wi' his breeks doon!"

Postscript.—This article was submitted to the L.M.S.R. for revision; with regard to superheating, it was stated that "Some of the original engines, both '5 P' and '5 X P,' had only fourteen elements, giving in the case of the latter a superheat surface of 227 square feet, and a steam temperature of about 500 deg. Fah. These have since been converted, and all the later engines have a normal degree of superheat round about 600 deg. Fah. The most representative boilers on these two classes have twenty-four elements, but the most recent class 5 engines have twenty-eight elements, giving a heating surface of 359 square feet and a steam temperature of about 612 deg., which figure is very comparable to that attained on the 'Coronation' class. 'No. 5459' has twenty-eight elements."

The matter of balance brought the following, which I give verbatim, because I do not altogether agree with it. One or two statements seem open to question, and as I know this is a controversial subject, readers can form their own opinions, and will perhaps state them.

"A three-cylinder engine, whether driving the same or separate axles, will give a very much reduced hammer blow *per axle* compared with a two-cylinder, but will give a quite considerable hammer blow *per wheel*. That is, a two-cylinder engine delivers its hammer blow on both wheels of an axle simultaneously—on a three-cylinder it alternates, first on one and then on the other. Only the four-cylinder eliminates the hammer blow under either circumstance.

"Whether the drive is on one axle or divided makes little practical difference to the hammer blow effect on a three-cylinder engine, since it is divided amongst the three axles in each case."

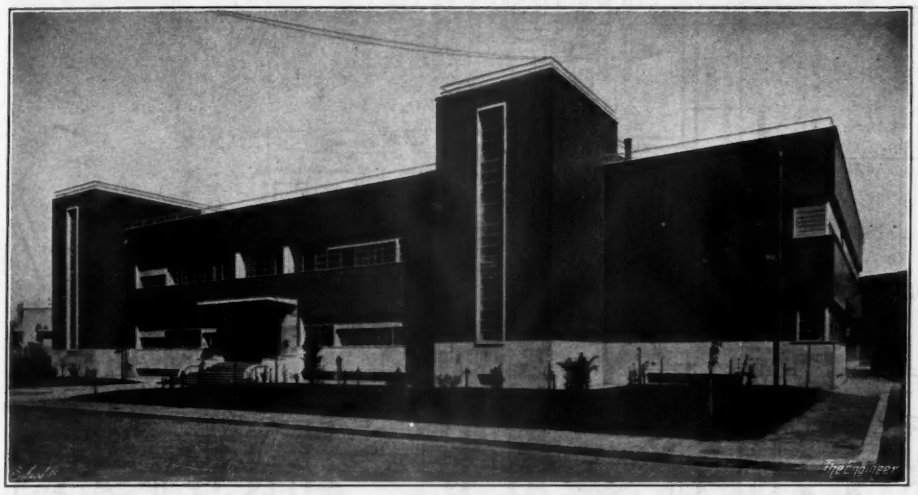
(To be continued)

North East Coast Institution.—The Annual General Meeting of the North East Coast Institution of Engineers and Shipbuilders was held on Friday, October 13th, in Newcastle, when Major T. Russell Cairns delivered his presidential address, and the Report of the Council for the session was presented. The Council of the Institution is making every endeavour to continue the work of the Institution, despite the difficulties involved by war-time conditions. Arrangements for the holding of meetings from now until April have been made, it being realised that it is particularly the duty of the Institution to resist any tendencies that might develop, owing to the exceptional circumstances, to neglect the all-important task of ensuring progress in engineering and shipbuilding through scientific study and the dissemination of technological information. The Council Report shows that the Institution had a busy and successful session during 1938–9. There was a slight increase in the membership. An interesting point in the Report is the continued development of the Institution in Sunderland. The Branch that was formed there two years ago as an experiment has proved so vigorous that at the request of the members in Sunderland it has been decided to give it a definite establishment.

Aviation Experiment Centre, Guidonia

AN Aviation Experiment Centre has been built at Guidonia by the Italian Government. The Superior Direction of Studies and Experimentation there has a considerable number of laboratories at its disposition, equipped with modern plant, and permitting both speculative and practical, scientific, and industrial research into this particular industry. Illustrations of the laboratory accompany this article.

In order to understand the arrangement of the laboratory, it may be well to mention the divisions into which its work falls. These are five in number. (1) Material division, comprising sections of aerodynamics and hydrodynamics, development of engines, and test section for both models and complete machines. (2) Instrument division, flying instrument section and photography section. (3) Chemico-technological division, with a technological section, physico-chemical section, fuel study section and inorganic chemistry laboratories. (4) Radio-electrical division, which studies wireless in relation to aviation. (5) Experimental Division, which serves as a co-ordinating organism between the others and has the general direction of experiments.



THE RADIO-ELECTRICAL BUILDING OF THE GUIDONIA CENTRE

AERODYNAMIC SECTION

This section has seven large wind tunnels and two secondary tunnels, installed in three buildings. Four of these are arranged in a single hall in one building. They have a diameter of 2 metres, and are of circular section, in concrete. In these tunnels experiments are carried out at normal atmospheric pressure, so that the models under test are suspended in the open between the two ends of the tunnel, one of which ends in a blower, the other in an inlet funnel. Air movement is obtained by means of air screws situated in the tunnel. Each screw is driven by a 450 H.P. electric motor operating at 1000 r.p.m. The maximum wind velocity obtainable is 75 metres per second. The first of these four tunnels, specially given over to air screw experiments, is provided with a synchronous motor operating on variable frequency, which can be run up to a speed of 6000 r.p.m. Automatic balances are used to measure the traction exercised by the screw.

In the same building a fifth vertical tunnel of 3 metres diameter is installed. This is used for testing model aircraft, built exactly to scale, which are released inside the gallery without mechanical means of suspension, and are sustained only by the rising air current. An air screw driven by a 150 H.P. motor provides this current, which has a maximum speed of 30 metres per second. The behaviour of the model in this air current is filmed to permit exact studies.

A separate building is given over to a stratospheric tunnel. This is completely built of steel tubing, resting on a concrete foundation independent of that of the building, and operates on a closed circuit. Thirteen air speeds can be obtained by means of a screw operated by a 2850 H.P. electric motor. A refrigerating equipment is incorporated in the circuit to control the temperature of the circulating air. The installation as a whole permits tests to be carried out at speeds equivalent to 2500 kilometres per hour, and at pressures of one-tenth of an atmosphere. This tunnel, considered the most important of its type in the world, will, it is hoped, permit experimental progress to be made in the domain of stratospheric aircraft which in the past have been based on theoretical considerations.

The seventh of the tunnels, also installed in a building of its own, is provided with a Crocco type double return pipe. The test section is 3 metres in diameter and permits speeds up to 120 metres per second to be obtained. The air screw used is of a six-blade type, diameter 5·4 metres, and is driven by a 1800 H.P. electric motor. This tunnel is particularly intended for experiments on the subject of interference.

HYDRODYNAMIC SECTION

The canals provided for this section represent what was probably the most difficult and delicate job encountered in the whole Centre. The experimental basin comprises eleven sections, and has a usable length of 442·5 metres with a total width of 6·5 metres and a depth on the axis of 3·55 metres. The capacity is 10,800 cubic metres of water. It is equipped to permit tests of hulls, individual floats, or whole hydroplane models to be made and the resistance encountered by moving submerged objects and hydroplanes when taking off to be measured.

Movement of the models in the water is obtained by means of a truck running on four wheels on tracks which flank the basin. Directly connected to the shaft of each of the four wheels is an 18·5 kW d.c. motor, designed to permit a 100 per cent. overload during one run of the basin. This truck supports an automatic dynamometer to which the model is attached and which provides a curve of resistance in relation to time. Speeds are indicated on this graph by a system of photoelectric cells spaced 5 metres apart along the whole length of the basin, which operate a marker to indicate distances. The truck can reach speeds of 72 kilometres per hour.

For certain tests with hydroplanes, this truck is unsuitable, as it introduces disturbing air currents which affect the exactitude of the results. For this reason tests of that kind are carried out with a special three-wheeled truck, running along one side of the basin and provided with a small projecting arm from which the model under test can be suspended. This truck, driven by a single 100 H.P. electric motor, can reach speeds of 145 kilometres per hour, sufficient to cause the hydroplane to take off. A cinema camera on the truck permits the whole operation to be filmed. Special precautions are necessary with this truck, however, to keep the operator from being injured as a result of the high acceleration attained. In order to keep agitation of the water surface at a minimum, the basin is provided with banks at the sides, drilled with damping holes, so that five minutes' time is sufficient to bring the surface back to rest after a test.

ENGINE LABORATORY

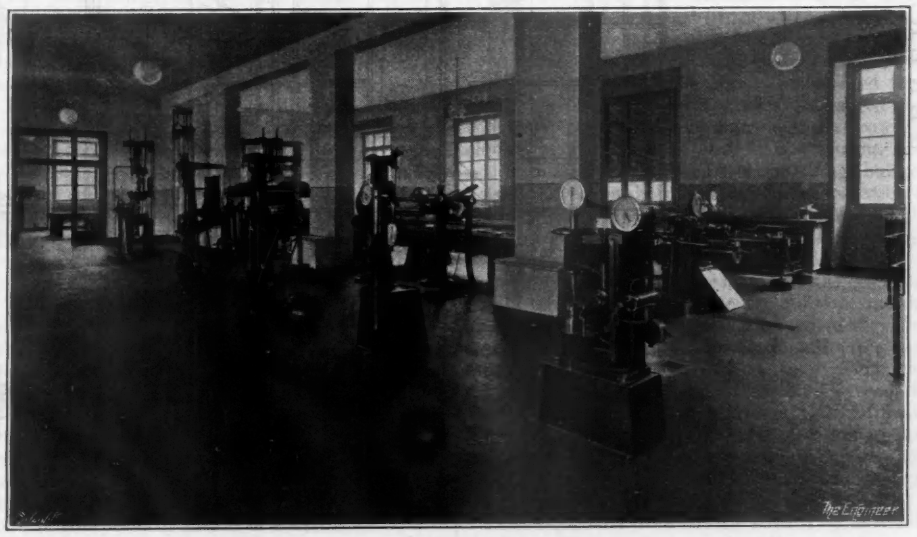
This section is provided with an extremely complete test equipment for engines and air screws. It can make not only the usual tests of consumption, power, and life of an engine, but can also test such points as feed systems, starting, ignition systems, lubrication, cooling, etc.

The brake horsepower is tested in three laboratories. One serves for water-cooled engines and is provided with five test stations. Braking is by hydraulic brakes. The other two are for air cooled engines, one for engines up to 1500 H.P., the other for engines up to 350 H.P. In each case the engine is installed in an air current which may reach 350 kilometres per hour, to reproduce its normal operating conditions. The power, up to 1500 H.P., is absorbed partly by hydraulic brakes and partly by electric brakes; that of the engines up to 350 H.P. is absorbed by two electric brakes which can be connected in series or in parallel.

Life is tested in another room. Here the engine, star suspended, is braked by reversed air screw blades fixed on to the shaft, acted upon by the air current set up by the ordinary variable pitch screw.

Besides these three main rooms, the section includes a pump laboratory, a laboratory for engines of less than 100 H.P., and finally, a laboratory equipped with single cylinder engines for fuel tests. There are also accessory test rooms, including notably a laboratory for the testing of tubes subjected to vibrations of variable frequency, set up by eccentrically rotating masses and for testing the resistance of air screws to mechanical stresses. This last comprises an installation with two 1000 H.P. motors with coupling and reversing mechanisms, the whole encased in a heavy concrete archway to prevent accidents in case of rupture of the screws under test. The tests can be made either in the dry or under an artificial rain.

Fuel supplies for the whole section are provided from a single central control installation. Here supplies of benzine, benzol, and ethyl alcohol are stored, the storage tanks being connected to a mixing installation which can provide a continuous

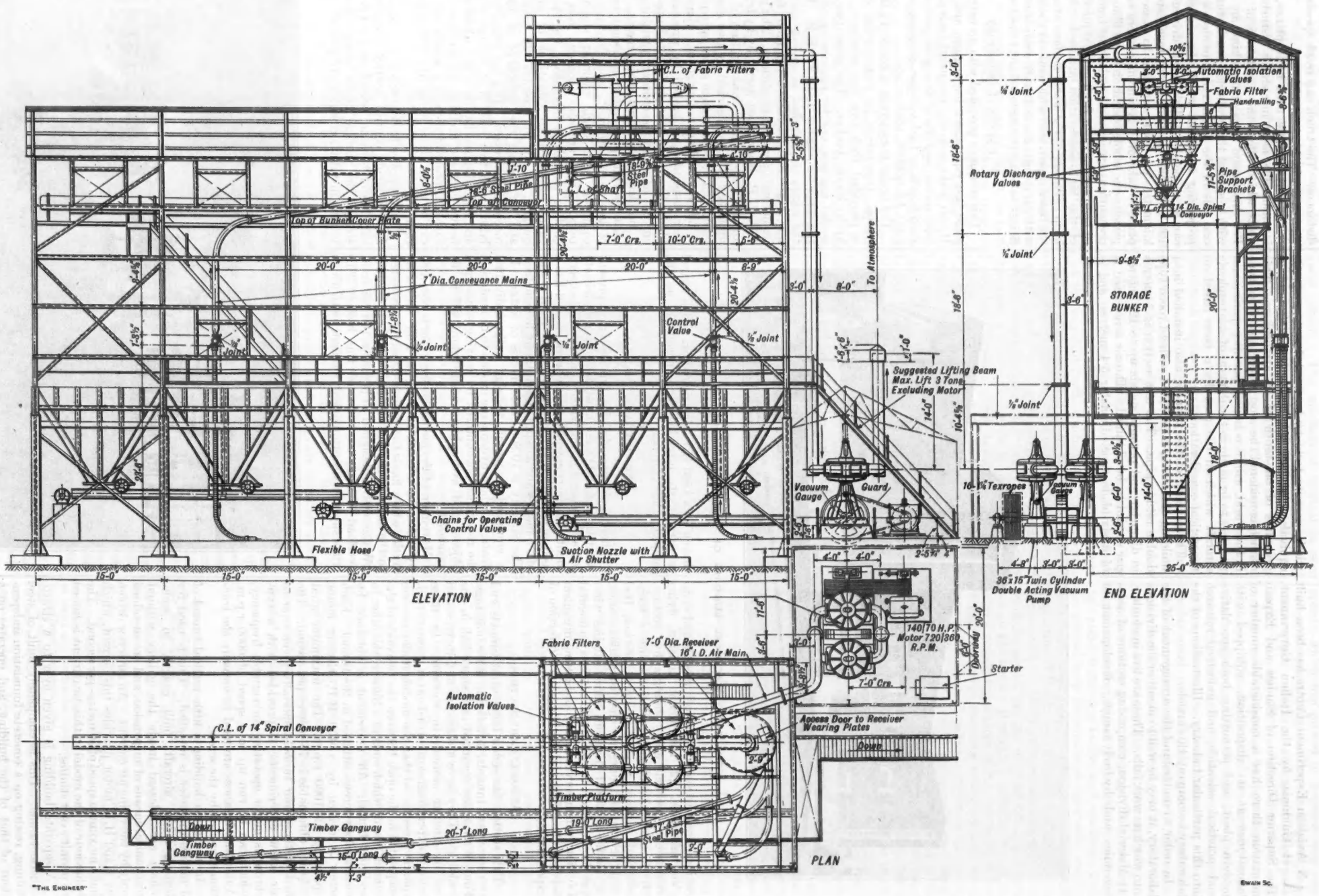


MATERIALS TESTING LABORATORY

GENERAL ARRANGEMENT OF PNEUMATIC ORE HANDLING PLANT

DAVIDSON & CO., LTD., ENGINEERS; ERNEST NEWELL AND CO., LTD., CONTRACTORS

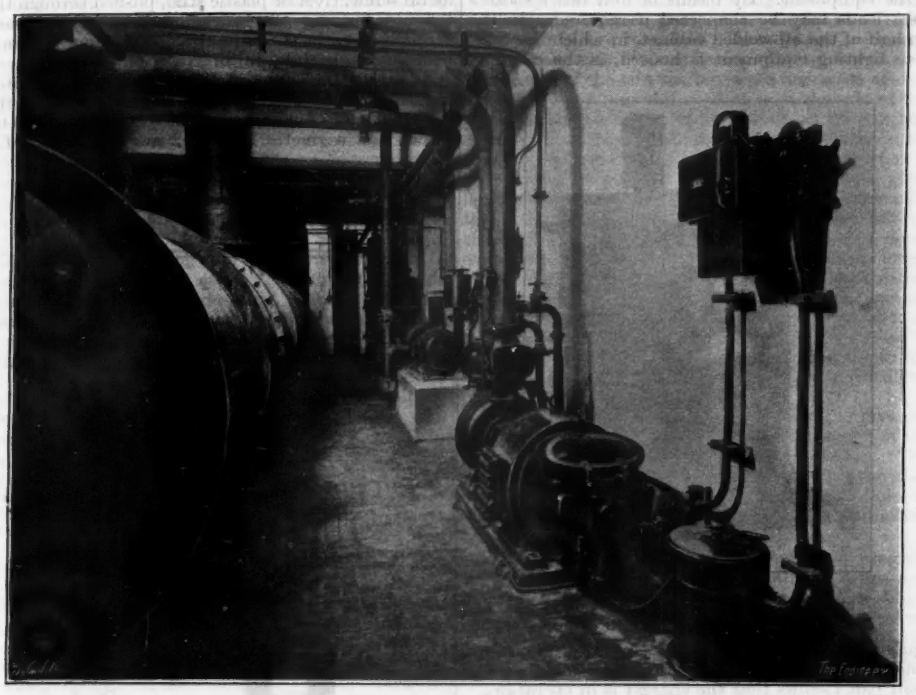
(For description see opposite page)



"THE ENGINEER"

EWAIN SC.

flow of any desired mixture of these fuels to each of the 14 engine stations in the section. Each supply is independently controlled so that each engine station can be fed with a different mix, as required. The system is provided with luminous indicators which control the flow of each of the fuels, and of the mixed fuel, for each of the stations, permitting variations or difficulties



STRATOSPHERIC MODEL TESTING DEPARTMENT

to be immediately detected and remedied. Cooling water and lubricating oil distributions are also provided. The lubricant is purified in centrifuges before distribution.

Model Shop

Most of the models tested in the Centre are built on the premises in a shop, specially equipped for the purpose. This greatly facilitates the making of changes in the models to correspond to the experimental data obtained.

Flying Instrument Section

The development of blind flying, in particular, has given flying instruments enhanced importance. At the centre, the Flying Instrument Section is equipped for testing the accuracy of the ordinary instruments, but it is intended also to engage in experimental work. The latter work will deal with the behaviour of chronographs and chronometers under varying temperature conditions. This involves not only purely physical studies, but also and more particularly a consideration of the lubricants used in these instruments.

The compass laboratory is designed for the study of terrestrial magnetism. In this laboratory one of the most interesting instruments is a solenoid coil designed to permit the magnetic conditions at any point of the earth's surface to be exactly reproduced, thus allowing experiments with compasses under conditions such as would be found anywhere. Here also are studied the various mechanical and physical phenomena peculiar to aeroplanes which affect the behaviour of compasses.

Fatigue of instruments through vibrations, a study of the nature of the vibrations in aircraft and the effects of acceleration and centrifugal action on instruments are studied. Thermometric, thermobarometric and gyroscopic laboratories are also provided. An aerodynamic gallery permits the tests to be made in winds up to 300 kilometres per hour.

Optico-Photographic Section

This is divided into various departments, for the study of cameras and optical instruments, and for that of photographic plates. The former comprises mainly testing equipment for lenses, shutters, and cameras of all sorts presented for acceptance by the army. Its equipment is sufficient, however, to permit it also to carry out experimental work on the improvement of photographic equipment.

The section dealing with plates not only tests plates already obtainable but is also provided with a complete laboratory for the experimental production of new types of plates. The analyses made include spectrographic, spectrophotometric, and ultramicroscopic examination of plates, as well as examination of their chromatic sensitivity, particularly in relation to the light obtained through various types of filters. The behaviour of both apparatus and plates can be tested not only under normal temperature conditions, but at temperatures between +40 deg. Cent. and −60 deg. Cent. Special sections are given over to cinema work.

Technological Section

This section works in harmony with the chemico-physical section, and is concerned particularly with the characteristics of the raw materials of all kinds used in aircraft construction. In the technological section apparatus is provided for tension, compression, flexure, shearing, torsion, and other ordinary material tests. The apparatus permits loads up to 50 tons to be applied. Special machines are provided for the testing of wires, cords, chains, textiles (particularly for parachutes), undercarriage wheels, etc. This section of the laboratory is particularly complete, providing apparatus for such tests as fatigue under torsion repeated at frequencies up to 3000 times per minute, and at temperatures from −60 deg. Cent. to +800 deg. Cent., rupture under rotary flexure at definite temperatures, and fatigue under repeated shocks.

Physico-Chemical Section

This section is concerned with the chemical composition, microscopic, and macroscopic structure of the materials tested. Thermic, magnetic, electric, and spectroscopic tests can be made of any material. A special department is given over to luminescent paints and artificial radioactivity. Another department deals with X-ray examination of both raw material and finished parts, before and after test.

Fuel Study Section

This section is really misnamed, as the study of the characteristics of fuels is only a small part of its work. It deals also with lubricants, paint, and varnish, determining their weathering resistance and their behaviour under various types of atmospheric conditions.

Other Laboratories

The inorganic chemistry laboratory deals mostly with the chemistry of metals and their alloys, with special attention to light alloys and ferrous alloys. An important part of the work of this laboratory is that of testing the resistance of various metals to corrosive agents of all kinds.

The activity of the radio-electrical division is to be directed both to testing radio and radio-goniometric apparatus, and to trying to improve and simplify the working of apparatus in use. Special laboratories are provided for the study of emitter tubes, and for mobile transmitters.

Besides serving as a co-ordinating organisation between the various departments of this complex structure, the experimental division has a field of its own, that of testing human beings in their relation to the aeroplane. For this purpose it has a stratospheric chamber in which a pilot can be tested, equipped with various heaters, breathing devices, etc. He can be subjected to temperatures down to −70 deg. Cent. and atmospheric pressures down to 77 mm. of Hg. corresponding to the conditions at 16,000 metres.

Pneumatic Ore-Handling Plant

THE pneumatic handling plant described in this article was supplied by Davidson and Co., Ltd., of the Sirocco Engineering Works, Belfast, and was installed in a wire rope works in the Midlands, through the main contractors, Ernest Newell and Co., Ltd. It forms an essential part of an installation for the purpose of storing up to 1500 tons of zinc ore in connection with a new process of electro-galvanising of wire for steel wire ropes.

The plant comprises the main storage arrangements for ore, and smaller works are supplied from this source, provision being made for discharging small quantities of ore for transport by road vehicles to the subsidiary works.

The ore arrives at the works sidings in rail wagons and the pneumatic plant is provided to unload the ore from the trucks and deliver it into an overhead storage bunker; the plant operates continuously until the entire shipload has been handled. Photographs reproduced herewith and on page 400 show various portions of the plant, and reproduced on the opposite page is an arrangement drawing of the complete plant.

There are four flexible intake pipes for unloading the material, each with its own suction nozzle fitted with a rake for the purpose of breaking up the material, which is inclined to pack together during transit. The pipe is of flexible rubber hose of special quality for the duty required, and is provided with a ¼in. thick special wear-resisting lining; a large degree of flexibility ensures ease of manipulating the nozzle. Each intake pipe is fitted with an isolating valve, controlled from the point of collection by means of a chain.

The plant is so arranged that any two intake pipes may be operated simultaneously, giving an unloading capacity of 30 tons per hour; alternatively, the installation may be run at half speed if it is only required to work one intake pipe. Under these circumstances the capacity is 15 tons per hour.

The ore handled is in the form of a powder from $\frac{1}{16}$in. to dust, weighing approximately 92 lb. per cubic foot and containing about 6 per cent. moisture. The maximum distance through which it is conveyed by the pneumatic plant is 124ft., which includes a vertical lift of 65ft.

The material is deposited into a "Cyclone" type receiver of heavy steel plate construction, where the bulk of the material is separated from the conveyance air stream, and is discharged continuously from the receiver through a rotary discharge valve delivering into a distributing conveyor running over the length of the storage bunker.

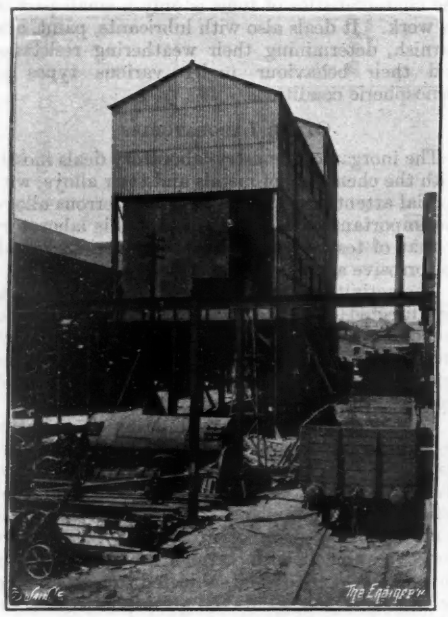
In order to obtain a high degree of separation of material from the air stream and to ensure that the air is thoroughly cleansed before passing through the vacuum pump, the receiver is followed by a battery of four multi-sleeve fabric filters. To maintain these units in an efficient condition, mechanically operated cleaning gear is provided. This gear is under automatic control and isolates each filter from the suction line in turn every two minutes for a period of approximately five seconds. During this period clean scavenging air is drawn through the filters in the reverse direction to that which normally applies, thereby collapsing the filter sleeves and effectively dislodging any material adhering to the surfaces of the fabric.

Dust separated from the air stream by means of the fabric filters is discharged continuously through rotary valves for delivery to the distributing

conveyor. All rotary valves, together with the mechanically operated filter cleaning gear and isolating valves, are driven from a common countershaft, receiving power through vee ropes from a 5 B.H.P. motor.

The clean air outlets of the filters are coupled together and led through a common main to a twin-cylinder vertical reciprocating vacuum pump of Robert Boby manufacture. This unit is specially designed for pneumatic conveying work, a feature being that the piston is a clearance fit inside the cylinder, thereby eliminating wear as well as the necessity for internal lubrication. The piston is maintained truly central by means of a trunk and tail rod guide. The inlet and outlet non-return valves are of the spring-loaded, rubber disc type, reinforced with metal plates, and are housed in an annular space around the main cylinder, and are readily accessible through four large inspection doors, provided on the outside of the cylinder casing.

The vacuum pump is driven through vee rope drive by means of a two-speed motor rated at 140 B.H.P. and capable of running at either



GENERAL VIEW OF PLANT

720 or 360 r.p.m.; at the last-named speed the power rating is 70 B.H.P. The exhaust from the pump is led directly to atmosphere, a suitable weatherproof cowl being provided at the outlet of the discharge pipe.

As previously mentioned, the pneumatic plant delivers the ore into a distributing conveyor mounted immediately over the storage bunkers. The conveyor is of the enclosed worm type, provided with suitable discharge points throughout its length, through which the ore is deposited into the bunker.

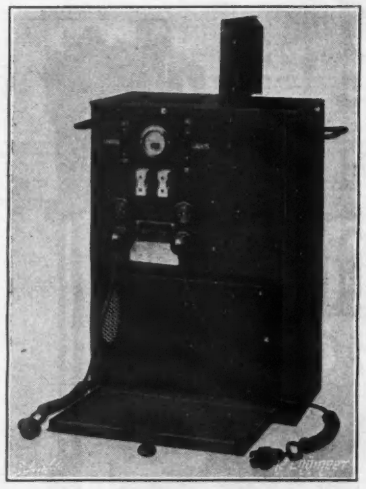
The main storage bunkers are fitted with hoppered bottoms having suitable valves through which the ore is delivered into a further series of totally enclosed worm conveyors discharging into an elevator which raises the material to a measuring bin fitted with suitable weighing apparatus. Ore is drawn from this bin by means of a belt conveyor, and is delivered in the required quantities to the mixing vats.

The whole equipment is of up-to-date design, arranged with direct unit drives and separate motors suitably interlocked to ensure efficient working of the installation.

When it is desired to load motor lorries for supplying other works, the ore is extracted from the main storage bunker by means of a worm conveyor which delivers to a reception bin fitted with discharge valves and flexible pipes for delivering to suitable containers which are used for road transport.

Emergency Lighting

In view of the necessity at the present time to take precautions against an entire black-out by the failure of electricity supplies, Philips Industrial, of Century House, Shaftesbury Avenue, W.C., has designed a self-contained emergency lighting equipment which can be brought into operation immediately on the failure of current. The small dimensions of the equipment, 24in. by 12in. by 8in., make it suitable for use in air raid shelters, doctors' surgeries, shops, hotels, &c., in fact, in any place where it is essential to have an emergency source of lighting should occasion arise. The approximate weight of the complete unit is only 35 lb. The equipment shown in the accompanying illustration comprises a 12-volt battery, charging equipment, flexible leads, and lamps. Two 9ft. heavy tough rubber flexible leads, each fitted with a 12-volt lamp and shield, are included ready to be plugged into special sockets on the front of the equipment. By means of four other sockets extra leads may be connected if required. In the top half of the all-welded cabinet, in which the complete lighting equipment is housed, is the charging



EMERGENCY LIGHTING EQUIPMENT

equipment, which enables the battery to be charged quickly after it has been in use, and a meter on the front panel shows that the charger is in operation.

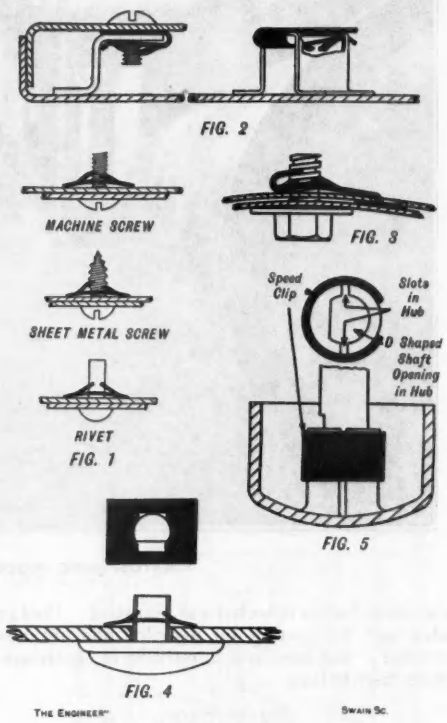
This charging equipment will operate on any standard A.C. mains supply of 200–250 volts, the capacity of the battery being such that the lamps supplied will give approximately twenty to thirty hours' continuous light. If the emergency lights should be required whilst the electric mains are still alive, a switch is provided to make this possible, and should be used to conserve the battery. If the mains supplies fail the switch is moved to another position and the emergency battery will at once light the emergency lamps.

The Speed Nut

On a recent visit to the works of Simmonds Aerocessories, Ltd., Great West Road, Brentford, London, we inspected a new system for the quick assembly of all manner of products, such as radio sets, automobile assemblies, electrical assemblies, and domestic stove and refrigerator units. Known as the "speed nut" system, this type of fixing was developed in America and has found many applications there. Speed nuts are claimed to provide an inexpensive and efficient vibration-proof fastening, from which the bolt, screw, or stud can be removed and replaced instantly. They thus enable assembly time and costs to be cut, a reduction to be made in the number of operations, and sometimes as many as four or five parts to be replaced by one nut. They avoid the use of welding, riveting, tapping, and spring washers and are of particular value for "blind" assemblies.

The speed nut, in all its various forms, is essentially a strip of spring steel, cold rolled steel, stainless steel, phosphor-bronze, or even aluminium alloy, stamped in such a manner that thread-engaging means are pushed up from the bowed surface of the strip. Practically any kind of machine screw, bolt, sheet metal screw, rivet or plastic stud, pushed through the tongues forming this engaging means, or turned through them in the normal screw fashion, is firmly held against withdrawal or vibration.

Several applications of the system are illustrated herewith. In Fig. 1 are shown applications of the standard speed nut to a machine screw, a sheet metal screw, and a rivet. In Fig. 2 an application of a



APPLICATIONS OF SPEED NUTS

U-shaped speed nut for blind assemblies is shown. Here a simple Z-shaped angle clip is welded to one member of the assembly, or a U-shaped clip can be used, as shown on the right-hand side of the engraving, if greater rigidity is required. The speed nut retains itself in the bolt-receiving position under spring tension. An arrangement is shown in Fig. 3 in which a special heavy gauge speed nut can be snapped through a slot in an automobile body, where it retains itself in a bolt-receiving position. An extension seals the slot and the nut provides a blind bolting means for the attachment of motor-car wings and other heavy components. It will be noted that an arm at one end engages a second thread, providing a double grip.

In the case of plastics, integrally moulded studs are all that are required for the attachment thereto of many small components. Particularly useful in this connection in the case of wireless and electrical components, standard speed nuts or adaptations

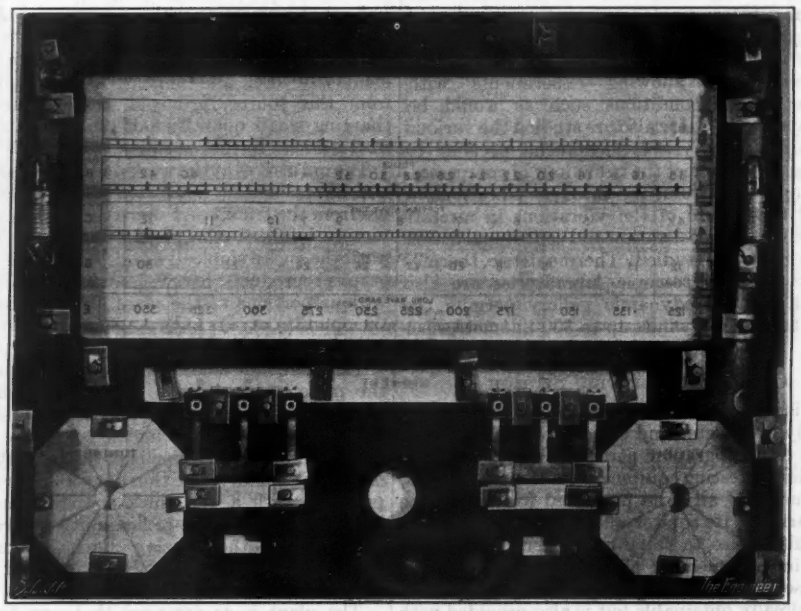


FIG. 6—UNDERSIDE OF RADIO PANEL

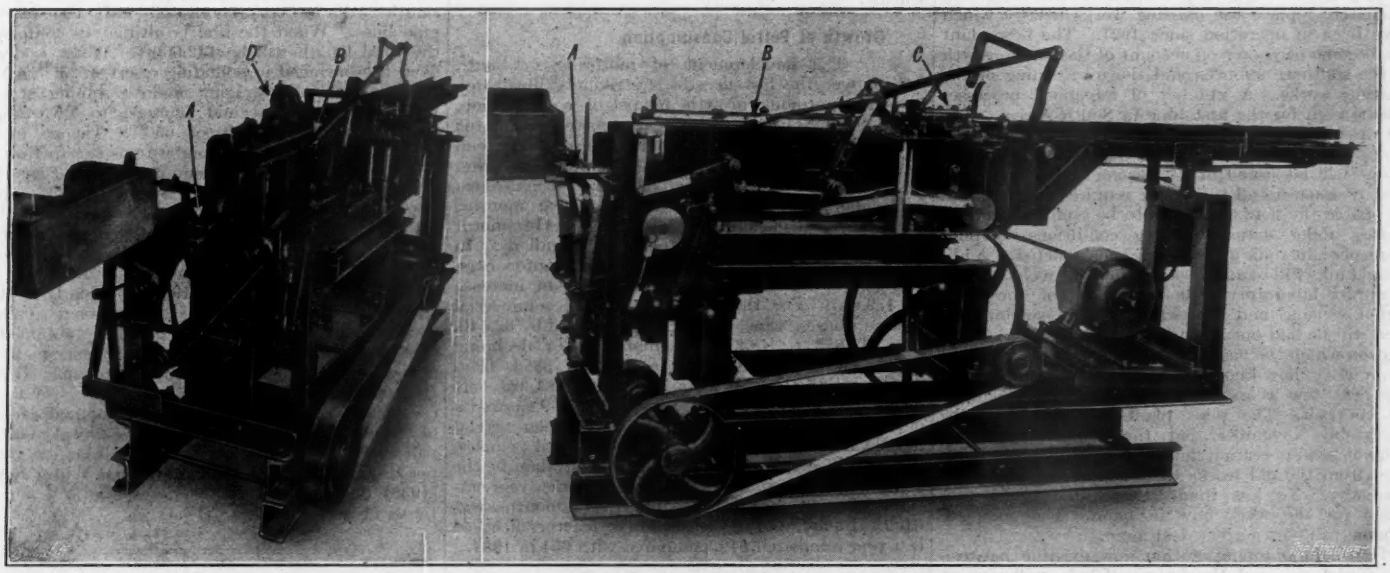
therefrom can be rapidly pushed over the studs, firmly attaching the components. In Fig. 4 is shown the method by which a stud is integrally moulded on a plastic button, knob, or trimming. If the stud be made D-shaped as indicated, the component can be readily detached by giving the nut a quarter turn. In Fig. 6, the underside of a radio set panel is shown, in which a number of applications of the speed nut principle is used. Name plates, trade marks, &c., either die castings or moulded plastics, can be quickly and firmly attached to products similarly, or two plastic components can be slidably assembled by means of speed nuts, the nuts automatically providing the correct amount of friction between the two.

A variation in the many types of nut and clip developed for special applications is illustrated in Fig. 5. Known as a "speed clip," it is suitable for knob assemblies and forms a simple compression ring. When adapted to thermo-plastic materials it is claimed to overcome "cold-flow" tendencies and eliminates the necessity for inserts. It is also claimed to lower the cost of the knob mould by eliminating webbing for reinforcing the hub, and enabling a thinner hub wall to be used. The hub is moulded with slots down two sides and with a D-shaped opening for a D-shaped shaft. Alternatively, it can be moulded with a round opening for a round shaft with a plain or knurled end. The speed clip is snapped over the slotted hub with a special tool developed for this purpose.

Many other special applications, too numerous to describe, have been developed by the company; in fact, there are more than 500 such applications already standardised and in use.

Tablet Packing Machines

A NUMBER of packing machines for sweets, tablets, &c., which incorporate several interesting features have been designed and constructed by Mr. T. Hudson of H.L.B. Motors, 11, Gooseyard Street, London, E.C.1. These machines, which work in conjunction with wrapping machines, automatically pack the wrapped tablets in boxes ready for closing and sealing. In the accompanying illustration is shown a machine recently completed which is designed to pack twelve tablets 1in. square in boxes 4½in. long at a speed of twelve boxes per minute. This machine is driven by a small ¼ H.P. electric motor. The tablets are fed into it from a tray on the left-hand side. It can readily be adapted for driving from a line shaft or directly from the wrapping machine it serves. The feed can also be arranged to be taken direct from the wrapping machine.



TABLET PACKING MACHINE

In operation the wrapped tablets are fed by a moving belt, along a guide channel, from the tray to a stop where a reciprocating feed finger A pushes them, one at a time, into the feed channel of the machine. As each tablet is pushed into this channel it is carried up by a second reciprocating feed lever to be held firmly, but not rigidly, between the bristles of two brushes which form the side walls of the channel. Each succeeding tablet pushes the previous one forwards between the bristles until a block of twelve is formed ready for packing in a box.

When the block of tablets is built up the travelling carriage B passes to its rear along a hinged guideway, which, through a system of levers, is elevated so that a finger depending from the carriage clears the block. The guideway then drops to place the finger at the rear of the tablets. The carriage is then drawn towards the centre of the machine, the finger pulling the block of tablets along a guide channel, beyond the brushes, until they are deposited on the packing platform beneath the centre of the filling plate C. The various movements of the travelling carriage are controlled by a central cam-shaft driven by chains at the rear of the machine. During these movements another block of tablets is being built up between the brushes. The filling plate lies across the width of the machine, and on it are mounted the box positioning, filling, and righting mechanisms.

Empty boxes are fed to the filling plate on a moving belt running between guide plates on the front right-hand side of the machine. These boxes are placed on the belt with their open tops facing downwards. At the end of the belt the boxes are deposited against a stop on the filling plate. A slide at the side of this plate pushes each box in turn over an oblong hole directly over the packing platform on which the block of tablets is situated. Here the empty box is held firmly in position by a hinged pressure plate having side flanges which serve to centre the box over the hole. The pressure plate is normally held up clear of the boxes by a spring and is closed down over them by an extension depending from the levers of the sliding carriage. It is held closed by a catch.

The packing platform is mounted on a vertical slide which is moved up and down by a rocker from the cam shaft. Its movement is so timed that it rises with the block of tablets and pushes it into the empty box directly it is held over the hole in the filling plate by the pressure plate.

At the top of the box packing stroke the pressure plate moves over with the filled box to the side of the plate towards the box-righting mechanism. The pressure plate assembly is incorporated with the slide which feeds the empty boxes over the filling hole, so that as the former moves away from the hole another empty box is brought over it by the slide.

While the box changing operation is in progress on the filling plate the packing platform drops and the travelling carriage returns with another block of tablets to load upon it. As the carriage returns an overhead extension of its lever system trips the catch holding the pressure plate on the filled box. On the catch being released the pressure plate is pulled back on its hinges by its spring to clear the full box of tablets, which is left on the filling plate adjacent to the righting mechanism.

The pressure plate and slide are then returned by a spring to their respective filling and transferring positions on the plate. As the pressure plate passes over with the next filled box two pins projecting from its side push the box previously filled into the tipping frame D in which the boxes are righted.

The tipping frame comprises a hollow spindle provided with an inclined plate and having pegs to hold the boxes. Through the medium of gears actuated by a cam and levers the frame is given a complete half turn and when the boxes are righted they are pushed out of the frame by a shaft passing through the hollow spindle. The filled boxes pass on to a moving belt between guides and are carried off the machine on the opposite side to which the empty boxes pass into it.

One-Man Pouring Ladle

SOME interesting economies have been effected in a number of non-ferrous foundries of late years by the adoption of one-man pouring ladles in place of some of the older systems of travelling ladle, and the photograph reproduced in Fig. 1 shows a ladle of this type manufactured by the Modern Equipment Company, of Port Washington, in use on the foundry floor for the pouring of bronze alloy castings. The ladle shown receives metal from an electric furnace and the pouring now done by one man used formerly to be done by a moulder and two helpers. The rigid construction of the overhead gear and the anti-friction bearings used for the travellers enable the ladle to be quickly and accurately located over the runner gate, and a 10 lb. push is all that is necessary to run the ladle from one moulding box to another. Ladles up to 1000 lb. capacity are now in successful use operating upon this principle.

ONE-MAN POURING LADLE

It will be seen from the photograph that the ladle is raised or lowered by means of the large hand wheel, while pouring is effected by tilting the ladle by means of the straight shank at the side, which when returned to the vertical position can be locked by a safety clip on the side of the frame.

A Black-Out Switch

BLACKED-OUT or heavily curtained windows do not always provide sufficient protection against light leakage. However painstaking one may be, there is a constant risk that the opening of an outside door may project a dangerous beam of light. For doors through which there is continuous traffic, such as in departmental stores and some public buildings, the cost of the necessary but elaborate light traps will be justified; but in private houses and similar buildings a less expensive, but equally efficient arrangement is to be desired.

A "black-out" switch, marketed by J. A. Crabtree and Co., Ltd., of Lincoln Works, Walsall, is designed to give automatic protection against light leakage. The switch not only ensures that the light is instantly switched off as the door is opened, but

also switches the light on again immediately the door has been closed sufficiently to prevent leakage. It is entirely automatic in its action, and prevents individuals from making the mistake of opening a door while the light is on or switching on the light before the door has been closed. For this reason, it is especially applicable to the outside doors of houses, garages, out-buildings, military hutments, &c. The switch unit is of sturdy all-shockproof construction, and can be quickly and easily connected in the existing electric wiring. The unit is offered for use in alternating-current circuits only, and must not be employed on D.C. mains supplies above 12 volts. The rating is 5 amperes, 250 volts, alternating current only.

South African Engineering Notes

(By our South African Correspondent)

Cape Town Docks Still too Small

Table Bay harbour is still too small for the shipping wanting to use it. Fears are being expressed that it will also be too small even when the present extension work is completed. Harbour authorities hold that the second half of the £6,000,000 expansion scheme should be sanctioned without delay so that there shall be no interruption when the contractors finish their work on the first section in 1941. As an emergency measure, two of the still unfinished berths, E and F, have been commissioned though the quays have not yet been surfaced, nor are their cranes or sheds there, but the wall is useful in emergency for accommodating ships that are not landing passengers or working cargo. In spite of the emergency commissioning, the congestion is so acute that when the 27,000 ton "Dominion Monarch" arrived from England with 280 passengers for Australia on August 17th, there was no berth for her. She had to wait in the bay for hours, while three other vessels lying in the bay waiting to load maize cargoes were obliged to wait 48 hours. The first half of the development scheme, which is all that Parliament has sanctioned so far, allows for only one more berth, G.

Huge Sewage Works at Cape Town

Near the Klipfontein Road, Athlone, near Cape Town, a huge scheme of modern sewage disposal works is beginning to take shape. The works are destined to deal with all sewage from Cape Town's suburb from Woodstock to Kenilworth, and will ultimately replace the existing works nearby which have been in operation since 1921. The new plant has become necessary on account of the rapid growth of the southern suburbs and the overloading of the existing works. A number of advanced processes will be used for the first time in South Africa. The entire process will take place inside closed concrete tanks and will be odourless. Gas arising from the sludge will be stored in a "gasometer" and will be used to generate all the power required on the sites. To enable the new treatment to be studied in all its phases under actual working conditions, a pilot plant of eight tank units is being constructed. Additional tanks will be added as required. An elaborately equipped laboratory will form part of the completed scheme and the whole of the surrounding area will be laid out as park lands. The site adjoins that on which the vast new township for the coloured community, now known as Q Town, will arise within the next few years. The plant is being installed by contract. The pilot plant is expected to be ready by November, but the completed scheme will not be in operation until next year. The changeover from the old works to the new will take place gradually. No less than £180,000 has been provided for the work now in hand. The complete scheme will cost a great deal more.

The main pumping station now existing between the Rodebosch and Mowbray golf links will remain, as well as all the existing sewer connections. The disposal works only are being replaced. At present the sewage is pumped to the existing works near Bokmakirie, where in a series of tanks the solids are separated and digested, and the effluent is passed through brushwood, biological filters, and finally over fields for purification. Considerable difficulty, however, is experienced in view of the extraordinary amount of trade waste which is discharged into the sewers to-day. Wool waste, which comes from factories after the wool-washing process, is a particular nuisance. This waste forms a thick scum over the sedimentation tanks and prevents the gases from escaping. Special measures have to be taken to ensure complete digestion of this waste. Other wastes are also noticeable on particular days, and these call for special treatment dictated by municipal chemists who are located on the site and who make daily analyses of the sewage. Monday —washing day—is an example. An abnormal quantity of soap froth and fat are detected at the laboratory, and special treatment is prescribed to avoid the clogging of filters. On other days, chemicals and other wastes from breweries, sweet factories, and other industries are predominant and call for special treatment. Many of the difficulties, however, will be overcome at the new works, where the sewage will first pass through a mechanical flocculator, designed to increase the efficiency of sedimentation. This is an entirely new feature of sewage works in South Africa.

From the flocculator the sewage is pumped through enclosed biological filters, thereafter the process of separating sludge from the effluent is repeated twice in various tanks—another novel feature; sludge from all tanks is finally treated in a multi-digester consisting of two large sealed tanks; the gas is put to commercial use on the site and the final sludge, when dried, finds a ready market among all the sporting bodies on the Peninsula who have fields and grass lawns to maintain. It may be stated that the sewage from Bakoven to Clifton goes to sea at Camps Bay; the whole of the city sewage including Sea Point is similarly discharged to sea in the raw state through the underwater outlet pipe off Mouille Point, the Wynberg–Plumstead sewage is disposed of at works beyond Zeekoe Vlei, while the Muizenberg–Kalk Bay sewage is pumped to the sand-hills far out in the direction of Strandfontein. A combined sewerage scheme for the northern suburbs of Cape Town has been submitted to the Divisional Council. It is estimated to cost £30,612. It is recommended that the local bodies concerned should not be called upon to pay a higher share of the cost because of their greater distance from the point at which the sewage is disposed of.

New Street Lighting System

A modern system of street lighting in the main traffic arteries of Cape Town is shortly to be undertaken by the City Council. The estimated cost is £60,000 to £70,000, which it is proposed to spread over a period of three years. In considering the scheme the municipal engineers are agreed that wherever it is impossible or impracticable to erect poles and cross-arms on the boundary of roads, without projecting over private properties, the correct position for the supports would be immediately behind the kerbstone to give a clearance of eight to ten inches between the edge of the roadway and any support. The scheme will necessitate a certain amount of experimental work, and the electricity and waterworks committee recommend the Council that the first route to be dealt with shall be from the old tram terminus in Wynberg to Muizenberg. The report states that this may be taken as a representative section of the road, and will provide all the information necessary as to cost and type of fittings to adopt. The Committee recommends that the city electrical engineer be authorised to proceed with the scheme.

Growth of Petrol Consumption

The development of motoring in South Africa over the last decade is strikingly illustrated by the enormous growth in petrol consumption, from 49,106,811 gallons ten years ago to 155,215,168 gallons last year, showing an increase of 106 million gallons. On an average 158,838 motor vehicles, licensed throughout the Union in 1928, each consumed 310 gallons of petrol during the twelve months, the average consumption of the 376,414 motor vehicles licensed in 1938 being 412 gallons. In 1928 the Union had 113,000 licensed motor cars, this figure becoming 302,069 in 1938—an increase of 189,067. For the ten years period commercial motors ('buses, vans, and lorries) increased by 36,540, from 11,672 to 48,212, the motor cycles' declining popularity being shown by a drop of 8850, from 34,164 to 25,314. As compared with 281,981 cars licensed in 1937, last year's total of 302,069 showed a net increase of 20,088. Of the 48,212 commercial motors licensed last year, 869 were fuel oil vehicles, this classification appearing for the first time in the 1938 Census Office returns. With 8960 new registrations, the net increase for the twelve months was 6109. Including 162 fuel-oil units, tractors licensed last year numbered 819, compared with 651 in 1937.

Blast Furnace Blown in

The Newcastle blast furnace was blown in successfully on August 30th after the initial lighting up on the previous day. A small gathering was present at the relighting operation, including several officials from the Pretoria Iron and Steel Works. The Newcastle blast furnace has been idle for a long period. It originally supplied pig iron to the Union Steel Corporation Works at Vereeniging, but when the Pretoria works was in a position to supply the Newcastle furnace closed down. The first cast from the newly restarted furnace was taken the next day. The furnace will be producing pig iron for about two months, after which it will be put on to production of ferro-manganese. It is understood that arrangements were being made to export ferro-manganese to Great Britain, and it is expected that the furnace will be kept in blast for a long period. Precautions are taken to guard the works and no unauthorised person is allowed on the property.

Difficulties in Buying British

Dr. John Hamlin, City Engineer of Johannesburg, who was recently over in England, has been protesting against restrictions which, he says, make trade with Britain difficult. The five largest cities in the Union would not buy foreign material if they could help it, he said, yet he himself had had considerable trouble in obtaining supplies of steel and bitumen. While tenders came in from Germany and Belgium for a consignment of tram lines there was no response from Britain until a direct approach was made to the Board of Trade. Finally, one tender came from a British firm which had given the order to Germany first. Dr. Hamlin blamed chiefly the International Cartel for this state of affairs. He added that they could not buy machines for manufacturing boots from Britain, but could only lease them. A firm which refused to be tied down in this respect had had to buy machines from Germany.

Rand Water Board

The phenomenal increase in the demands by consumers during recent years was maintained during the year under review in the report of the Rand Water Board for the year ended March 31st, 1939. The consumption for that year averaged 41,577,326 gallons a day, exceeding that of the previous year by over 32 million gallons a day. The total consumption of water during the year varied to an extent of 26·92 million gallons a day, between a maximum of 58·762 million gallons on November 23rd, 1938, and a minimum of 31·841 million gallons a day on April 24th, 1938. The area of the Rand Water Board's limit of supply amounts to approximately 1959 square miles. The population within the Board's limits of supply totals 1,139,854, of which 436,369 are Europeans and 703,485 non-Europeans. The Board's sources of water supply consist of the Vaal River from which, under agreement with the Government, the Board has the right to abstract from the Vaalbank Dam 150,000,000 gallons per day, and also 10,000,000 gallons from the Klip River and from wells. At present, the net capacity of the mains for pumping into supply, after making deductions for leakage, wastage, etc., is 58,100,000 gallons of water per day. The total quantity of water sold during the year was 15,175,724,000 gallons, as compared with 13,841,457,000 gallons in the year 1937–1938. The Board now controls 422 miles of pipe lines made up of 409 miles of pumping and gravitation mains and 13 miles of collecting mains from boreholes and wells. The system extends from the Vaal River to Vereeniging and to the Central Rand, a distance of 36 miles, and along the Witwatersrand from Librauow on the West to Nigel on the East, a distance of 80 miles. During the year 60 miles of new pipe lines were laid and 24 miles of old mains lifted. The largest pipe so far employed is 54in. diameter, of which 95,000ft. is being laid as a first instalment of a new line. This length will be cross-connected into the existing pipe lines. When the line is ultimately completed, the total length will be 142,000ft. Water is drawn from the barraged impounding reservoir on the Vaal River to the Vereeniging main pumping station, where it is purified and pumped to Zwartkopjes pumping station, a lift of 650ft. Thence to the Yeoville and Forest reservoir systems is a further lift of 650ft. The annual consumption of coal has risen in the past nine years from 80,653 tons of a total value of £26,860 to 143,188 tons valued at £61,042. By the end of February, 1939, the first portion of the "1938 scheme" was completed giving a total water supply of 58·1 million gallons per day. But it had been found by December, 1938, that early in 1940 the requirements will exceed the present available supply, and authority was therefore obtained to proceed with further portions of the scheme, including a new 44in. diameter pipe line interconnected with two existing 33in. diameter pipe lines. With the completion of this pipe line, the combined capacity of the pipe lines from No. 1 and No. 2 intake stations will amount to a total capacity of 113 million gallons per day. The cost of the Additional Water Supply (1938) Scheme and the works authorised to date totals £1,284,200.

The Institute of Marine Engineers.—An examination for admission to Associate Membership of the Institute of Marine Engineers is to be held on May 20th to 27th, 1940. The annual examination for admission of Probationer Students and Students will be held on May 20th to 28th, 1940. The Institute's examinations are held in London and other centres according to candidates' places of residence. Full particulars of the syllabus and exemptions allowable may be obtained on application to the Secretary, The Institute of Marine Engineers, 73, Amersham Road, High Wycombe, Bucks.

The Institution of Electrical Engineers.—It has been decided by the Council that as many as possible of the activities of the Institution should be carried on during the period of the war in the same way as hitherto, and that the Library and Headquarters of the Institution should remain for the time being in the present building at Savoy Place, W.C.2. The Library hours will remain unchanged until Saturday, October 21st, 1939, after which they will be as follows:—From October 23rd until November 18th, 9.30 a.m. to 5 p.m. (Saturdays 9.30 a.m. to 12.30 p.m.) From November 20th until further notice, 9 a.m. to 4.30 p.m. (Saturdays 9 a.m. to 12 noon.) The Council, with considerable reluctance, has felt it advisable to cancel all meetings that were to have been held in London for the reading and discussion of papers, during the first half of the session, and the only meetings to be held will be two formal Ordinary Meetings for the election and transfer of members in accordance with the provisions of the bye-laws. The Committees of the Local Centres and Sub-Centres have also, except in one or two instances, temporarily suspended their local programmes.

Rail and Road

ELECTRIC VEHICLE CHARGING.—We learn from the Electricity Commissioners that electricity for charging electric vehicles is not to be rationed.

HORSE-DRAWN TRAFFIC IN LONDON.—The ban on slow moving and horse-drawn vehicles in certain areas in London during specified hours has been withdrawn.

PRODUCER GAS-DRIVEN VEHICLES.—Following consultation with the Secretary of Mines, the Minister of Transport has made an order permitting public service vehicles to draw a trailer equipped with producer gas plant. There is nothing in the regulations to prevent a goods vehicle from drawing a trailer.

GERMAN RAILWAY COLLISION.—It is reported that on the night of Sunday, October 8th, an express train from Sassnitz collided with a passenger train at the Stargard Station, Gesundbrunnen, Berlin. The number of persons injured and killed has not been stated, but it is estimated that there are at least twenty fatally injured.

TRAM ROUTES BEING RETAINED.—At the outbreak of war a number of towns had schemes in hand for the replacement of trams by trolley buses and oil-engined buses. A number of these schemes have now been abandoned and tram routes are being retained. Towns recently announcing the postponement of conversion schemes include Blackburn, Bristol, and Cardiff.

MOVING A HEAVY RAILWAY BRIDGE.—On the Central Argentine Railway, near Miguelete Station, a steel railway bridge weighing 225 tons has been moved into position over the Avenida General Paz. This bridge, states the *Railway Gazette*, weighed some 240 tons with the rails and sleepers taken into account. It was mounted on six bogies, beside the track, run into position and lowered on to its bearings. The rails were then bolted up and the ballast packed and boxed. It is stated that the work was carried out in three hours.

LIGHTING OF TRAINS IN LONDON.—The London Passenger Transport Board announces that the equipment of railway carriages with restricted lighting facilities on all its lines has now been completed. With a view to effecting some improvement in the lighting of trains on the underground systems, when running in the open sections during a blackout period, a trial is being made with the consent of the Home Office of the effect of removing the blue paint from the lower part of the night bulb of the present low wattage lamps.

PRIVATELY OWNED RAILWAY WAGONS.—The Minister of Transport has appointed a Committee to advise him upon questions arising out of the requisition of privately owned railway wagons. The Committee consists of representatives of the Ministry of Transport, the Mines Department, the Railway Executive Committee, the Association of Private Owners of Railway Rolling Stock, the Scottish Wagon Owners' Association, the Association of Wagon Repairing Companies, Hirers Limited, the Railway Carriage and Wagon Builders and Financiers Parliamentary Association, and the Mining Association of Great Britain.

RESTAURANT CARS RESTORED.—The Railway Executive Committee announces that on and from Monday, October 16th, limited restaurant car facilities will be provided daily on over 130 of the principal long-distance trains. The services will cater for the important towns on the various systems between which there is a heavy business and public service traffic. Twenty-six services will be restored on the Great Western Railway, thirty-six on the London and North Eastern Railway, forty-eight on the London, Midland and Scottish Railway, and twenty on the Southern Railway. Special alterations are being made to the restaurant cars to overcome the difficulties of black-out restrictions.

NEW ENGINES FOR FEDERATED MALAY STATES.—Six 4–6–4 tank engines have been built for the Federated Malay States Railways by the North British Locomotive Company, Ltd. They have two outside cylinders 14½in. diameter by 22in. stroke with rotary cam poppet valve gear driven from the middle pair of coupled wheels. Their leading dimensions are as follows:—Coupled wheels diameter, 4ft. 6in.; bogie wheels diameter, 2ft. 6in.; coupled wheelbase, 10ft. 11½in.; length overall, 43ft. 8in.; boiler pressure, 250 lb. per square inch; total evaporative heating surface, 853·5 square feet; superheater surface, 180 square feet; weight in working order, 74 tons; adhesive weight, 37 tons 7 cwts.; and tractive force at 85 per cent boiler pressure, 18,200 lb.

PROPOSED ELEVATED HIGHWAYS IN CHICAGO.—The chief engineer of the Chicago Plan Commission has suggested the construction of a 6 miles long super highway as a distributing loop for traffic to the several proposed roads radiating from the city. Three sides of the loop would be elevated and one at present street level. The proposed elevated sections would consist of duplicate and independent structures each 50ft. wide for traffic travelling in opposite directions. Blocks 55ft. wide would be taken along the sides of existing streets and the elevated roads built on either side with ramp connections down to the streets. Space beneath the elevated highways would be available for storage or other uses, having direct access to the original parallel streets. The double elevated highways would be 4½ miles long and the estimated cost is 35 million dollars.

OIL-ENGINED SHUNTING LOCOMOTIVES.—Operation results of two 44-ton oil-engined shunting locomotives of the General American Transportation Corporation are given in a recent issue of the *Railway Age*. Known as "Flexomotives" these engines, since being installed early this year, are said to have operated with an availability of about 98 per cent. with an average fuel consumption of 2·7 gallons per hour. It is expected that they will show an annual return of at least 50 per cent. as compared with the cost of former steam operation. Each engine develops a 27,000 lb. drawbar pull at 3 miles per hour. They have engines developing 340 H.P. at 900 r.p.m. and generally work at speeds between 600 and 800 r.p.m. Drive is through two compound epicyclic gear units from which four speeds forward and four in reverse are obtained by fingertip remote control.

Miscellanea

BOULDER DAM.—The recent installation of the eighth 82,500-kVA generator at the Boulder dam has brought the installed power up to about half the plant's ultimate capacity.

OILS AND FATS.—In connection with the Ministry of Food's control scheme for oils and fats, plans have been prepared by which sixty-three crushing mills, forty-six refineries, sixty-five margarine and compound cooking fat factories, and seven hydrogenating plants will be operated under the Ministry.

INTERNATIONAL MINE SAFETY CONFERENCE POSTPONED.—The Fifth International Conference of Directors of Mine Safety Research, scheduled to be held at the Central Experiment Station of the Bureau of Mines, United States Department of the Interior, Pittsburgh, Pennsylvania, September 25th to 30th, 1939, has been indefinitely postponed because of the war in Europe.

SHALE FUEL AT A RUSSIAN POWER STATION.—A power station of 24,000 kW to be built at Yzran in Russia is to use shale from the Kashpir mines as a fuel. The boiler to be installed will burn shale in the form of dust, the slack running off as a liquid. By removing the slack in this way the residue may be used as a raw material for the manufacture of building materials. A factory is to be erected near the power station for the conversion of slack into building materials.

SCIENTIFIC AND INDUSTRIAL RESEARCH.—The Secretary of the Department of Scientific and Industrial Research has announced that Sir Joseph Barcroft, M.D., F.R.S., Sir Harold B. Hartley, D.Sc., F.R.S., and Sir Frank E. Smith, D.Sc., F.R.S., have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The Rt. Hon. Lord Cadman of Silverdale, and Sir James Jeans, F.R.S., have retired from the Council on completion of their terms of office.

GRAPHITE LADLE ADDITIONS TO CAST IRON.—At many foundries graphite is added to iron at the cupola spout during casting to reduce the tendency of the iron to chill or form hard spots at the edges. Experiments have been carried out at the experiment station of the Ohio State University to determine the effect of the graphite additions on mechanical properties as well as on the chill depth. It was found that the additions, whilst definitely reducing the chilling tendency, do not affect the mechanical properties of the iron castings in any important degree.

BRIGHTON POWER STATION EXTENSIONS.—The electrical engineer of Brighton has reported that the Central Electricity Board has directed the extension of the Southwick Power Station by the installation of a turbo-alternator set having a maximum continuous rating of 50,000 kW. This set, complete with the boilers and works involved, was estimated to cost £471,000 and this price is now subject to variation owing to the war. In view of the extension the Brighton Electricity Committee is applying for the consent of the Commissioners to borrow £10,050 for the purchase of land adjacent to the station.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—In April last the Scottish Centre of the Institution of Electrical Engineers circulated a questionnaire to its members. The replies have now been received and analysed with the following results:—Replies indicated that 57 per cent. of the members find it most convenient to attend meetings in Glasgow, 30 per cent. in Edinburgh, and 11 per cent. in Dundee; that it is quite clearly indicated that it is not the wish of the members to have more than one meeting per month in each of the cities mentioned; and that, emphatically, arrangements should be made for the holding of more informal meetings.

DEMANDS ON THE BUILDING INDUSTRY.—In view of the heavy demands that are being made upon the building industry by the programmes of various Government Departments, the Prime Minister has invited Sir Connop Guthrie to undertake a continuous review of the whole position, including civil and industrial needs, for the information of the Government. Sir Connop has accepted the invitation and for this purpose his address will be the Board of Trade, Great George Street, S.W.1. It is not proposed that any change shall be made in the activities and responsibilities of existing bodies such as the Joint Consultative Committee on the Building Programmes of Government Departments and other Committees at present concerned with various aspects of the building problem.

STEEL COMPANY TO INSTALL IGNITRON RECTIFIER.—The first ignitron rectifier to be used in a steel mill, will be a 1000-kW, 250-volt Westinghouse unit purchased by the Carnegie-Illinois Steel Corporation at Braddock, Pennsylvania. This unit will be coupled with the plant bus and furnish power for miscellaneous direct-current equipment. The ignitron rectifier and associated apparatus will be designed to operate from a three-phase, 6600-volt power-supply system. The ignitron unit will consist of two assemblies of six ignition tubes, each being complete with equipment for maintaining and indicating vacuum. The unit will be rated 1000 kW at 250 volts direct current continuously with overload capacity of 125 per cent. for two hours and 200 per cent. for one minute. The rectifier unit will be completely automatic.

FIFTY YEARS SERVICE.—In recognition of having completed 50 years continuous service, Mr. S. B. Wilson, Director and Secretary of Glenfield and Kennedy, Ltd., Kilmarnock, was honoured at a complimentary dinner held in the Staff Dining Hall on October 5th. During the course of the evening Mr. E. Bruce Ball, Managing Director, on behalf of the Board, presented to Mr. Wilson the Gold Medal awarded on the completion of half a century's service, being the forty-sixth medal to be presented to members of the firm. Presentations were also made to Mr. Wilson on behalf of the Directorate, Management, and Staff. Mr. Wilson recalled that since his association with the firm the commercial office staff alone had increased from 18 to 94, and that the technical staff and employees in the works had expanded in the same proportion, the total number of employees to-day bordering on 2000.

Air and Water

NEW YORK'S NEW AIRPORT OPENED.—On Sunday, October 15th, the new airport of New York at North Beach, Long Island, was officially opened.

THE "QUEEN ELIZABETH."—When asked in the House of Commons if it was proposed to complete the construction of the Cunard White Star liner "Queen Elizabeth," the President of the Board of Trade said that the question was under discussion between the owners, shipbuilders, and Government Departments concerned.

NEW FRENCH MOTOR SHIP.—The *Journal of Commerce* reports that the keel has been laid of a large new French motor liner for the Marseilles–China–Japan service. The new ship will be 590ft. long, 75ft. beam, and is designed for a speed of 20 knots in service. She will be propelled by three eleven-cylinder, two-stroke oil engines, each developing 10,300 B.H.P.

THE LIFEBOAT SERVICE.—During the first month of the war, lifeboats of the Royal National Lifeboat Institution were launched 52 times to assist vessels in distress, and saved 191 lives. This year, up to the beginning of the war, lifeboats were launched 256 times and saved or helped to save 166 vessels and boats. The number of lives rescued for which awards were made totalled 246.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The October Journal of the Institution of Automobile Engineers appears in a cover which has been re-designed and with the reading matter in larger types for many of the features, and more distinctive headings. On the cover appears a reproduction of the new Seal adopted by the Institution as a Chartered Body. It is to be congratulated on both these improvements.

A TRANS-ATLANTIC STRATOSPHERE FLIGHT.—A Farman flying boat, specially equipped for flying in the stratosphere, completed a flight from France to Rio de Janeiro on the evening of Friday, October 13th, according to the correspondent of *The Times*. The machine, which carried a crew of four, made two halts at Dakar and Natal (Brazil). It maintained an average altitude of 24,600ft., the ceiling being reported as 29,500ft.

SHIPYARD LABOUR AND THE WAR.—Discussion between the Shipbuilding Employers' Federation and the Confederation of Shipbuilding and Engineering Unions at York have resulted in a considerable advance towards co-operation and agreement, although no definite decision has yet been reached. It is expected that a final agreement, with regard to proposals for speeding up and extending production of tonnage, will be reached at the next meeting, to be held at Carlisle on November 2nd.

BRITISH AND GERMAN SHIPPING AND THE WAR.—On October 12th, the First Lord of the Admiralty announced in the House of Commons that during the two weeks from September 24th to October 9th this country lost, by U-boat action, 5809 tons of shipping. In the same period we have captured from the enemy 13,615 tons, leaving a balance of 7806 tons in our favour. He went on to say that during the above period 50,000 tons of new merchant shipping has been launched by this country.

AMERICAN MERCHANT SHIPPING.—Contracts are now being placed almost daily for merchant ships by the United States Maritime Commission, and it is expected that the programme calling for fifty new ships a year for ten years will soon be far ahead of schedule. Ninety-three ships had been ordered up till recently, the latest order announced being for eight vessels costing about 2,277,000 dollars each. Eleven shipyards in the United States are now building ships aggregating 783,000 tons under the scheme.

NEW BRITISH TONNAGE.—Returns of the Registrar-General of Shipping and Seamen show that three steamships of 11,169 tons gross and sixteen motor ships of 35,733 tons were added to the register of the United Kingdom during August. Four steamships of 21,801 tons gross were removed from the register that month. It is shown that in the first eight months of this year the steamers and motor ships owned in this country have increased from 17,733,073 tons gross to 17,994,134 tons gross.

AIR MISSION TO CANADA.—In a statement to the House of Commons, the Secretary for Air said that the Mission which was proceeding to Canada in connection with air training would comprise, in addition to Lord Riverdale, Deputy-Air Chief Marshal Sir Robert Brooke-Popham and Mr. F. T. Earle, managing director of the De Havilland Aircraft Company. It has also been arranged for Capt. H. Balfour (the Under Secretary for Air) to proceed to Canada to assist in the arrangements to be made between the Canadian authorities and the Missions from Australia and New Zealand.

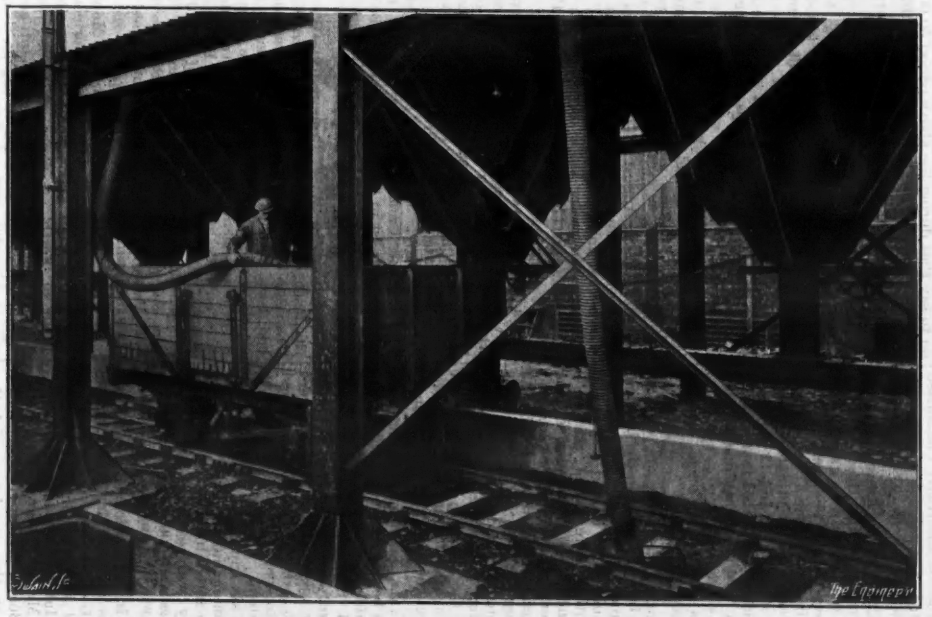
DEATH OF MR. W. F. ROBERTSON.—We regret to note the death, on Friday, October 6th, of Mr. W. F. Robertson, Chairman of the Clyde Navigation Trust since 1930. He had been a member of the Trust since 1918 and was closely connected with the extensive river widening and deepening schemes and the industrial development of sites on both banks of the river. He was a member of the Committee of Management of Lloyd's Register of Shipping and of the Glasgow Committee. Mr. Robertson was also chairman of the Clyde Pilotage Authority, and Vice-President of the Harbour Authorities' Association of Great Britain.

AIR RAID ON FIRTH OF FORTH.—On Monday afternoon, October 16th, twelve or possibly fourteen German aircraft carried out a bombing attack on Rosyth and the Firth of Forth. A series of raids was made. The German machines were attacked by anti-aircraft guns and fighter squadrons ascended to engage them. No serious damage was done. The cruiser "Southampton" was very slightly damaged by a glancing blow from a bomb which struck her bow. Three casualties were caused. Further casualties resulting from flying fragments and splinters occurred on the cruiser "Edinburgh" and the destroyer "Mohawk," amounting in all to 32. Four of the enemy machines were brought down, one apparently by anti-aircraft fire and the others by fighters. No civilian casualties are reported and the R.A.F. incurred no losses.

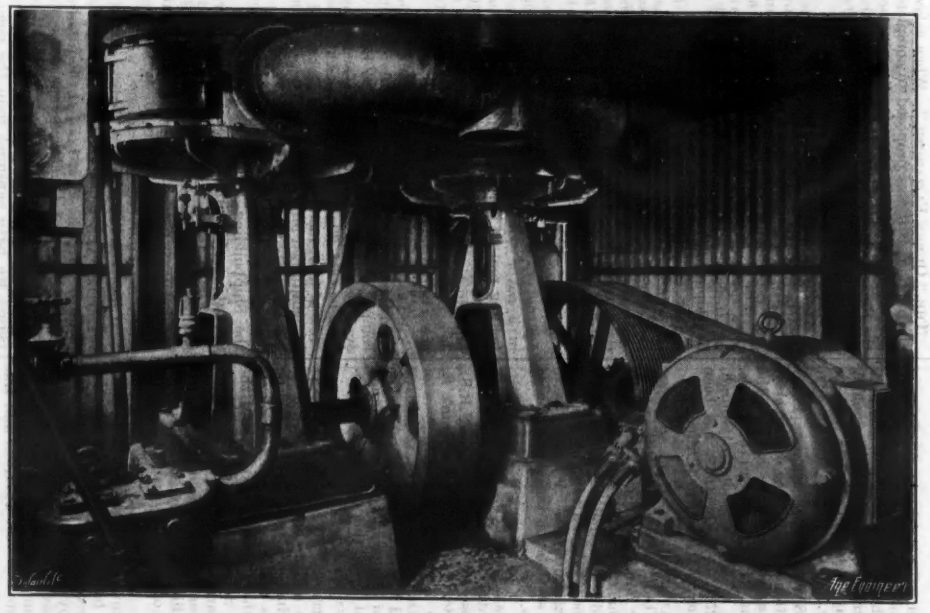
PNEUMATIC ORE HANDLING PLANT

DAVIDSON AND CO., LTD., ENGINEERS; ERNEST NEWELL AND CO., LTD., CONTRACTORS

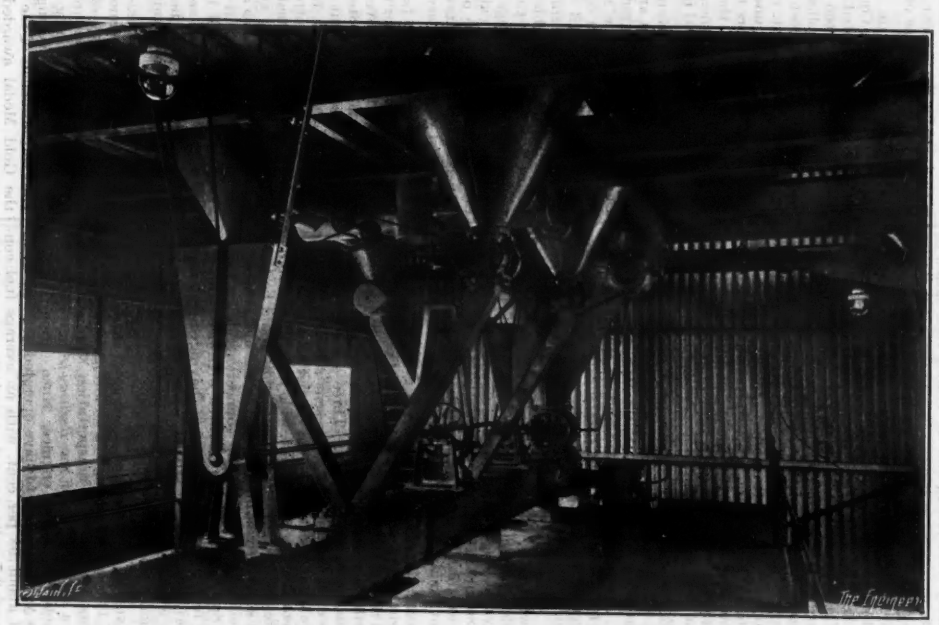
(*For description see page* 395)

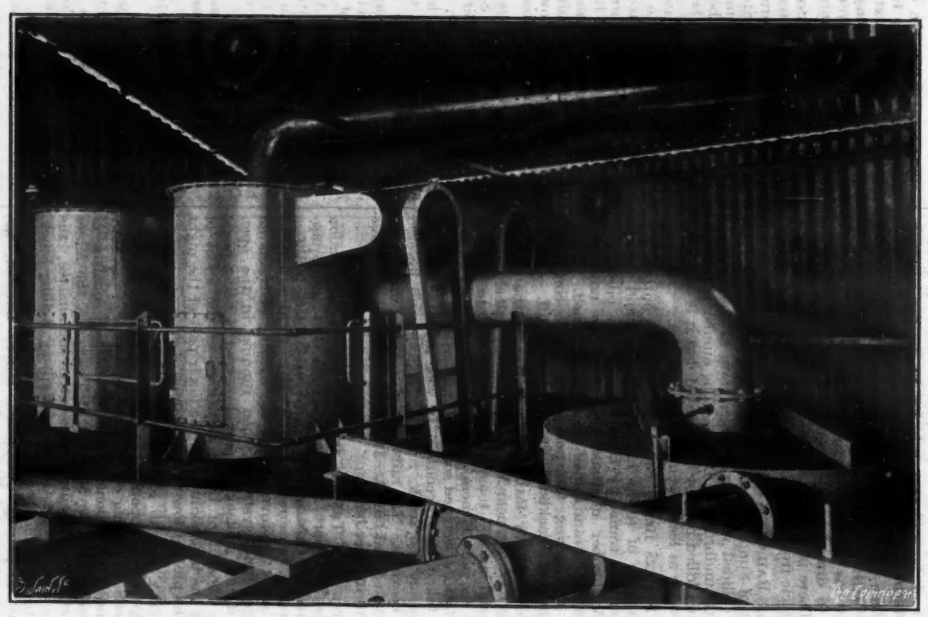


REMOVAL OF ORE FROM RAIL WAGONS
DISTRIBUTING CONVEYOR



TWIN-CYLINDER VACUUM PUMP
FABRIC FILTERS





The Engineer

OCTOBER 20, 1939

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NOTICE TO READERS

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

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**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS

**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new addresses**, *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

Postal Address: "The Engineer," 28, Essex Street, Strand, London, W.C.2.

Telegraphic Address: "Engineer Newspaper, Estrand, London." Telephone: CENtral 6565 (10 lines).

THE WAR IN THE AIR

So far, the war has taken a course confounding to many peace-time prophecies. It did not come suddenly like a bolt out of a peaceful sky. We were given much longer warning than in 1914, and during the six or seven weeks which have elapsed since Britain sent her ultimatum to Germany, we have been allowed almost undisturbed opportunity to mobilise the armed forces and the industries of the country for the great ordeal. One of the most widely expressed beliefs was that immediately on the outbreak of war Germany would attempt to deliver a devastating knock-out blow against this country from the air. Until Monday of this week when the enemy carried out a raid on objectives in the Firth of Forth not one single enemy bomb had been dropped anywhere within our islands. There was, too, a strong school of opinion which asserted that aircraft would render our command of the sea difficult if not impossible to maintain, and that aerial combined with submarine attack would play havoc with our merchant shipping. There has been more than one engagement between ships of the Royal Navy and enemy aircraft, but so far without material success from Germany's point of view. The most noteworthy instance of such an attack, up to the present, occurred on October 9th, when a British cruiser squadron in the North Sea was engaged by enemy bombers over a period lasting five hours. More than a hundred bombs were dropped. Some fell as much as a mile wide of their mark. The nearest to a direct hit was registered by one salvo, from which a few splinters were thrown on to one of our cruisers. There is no record of the enemy having employed torpedo-dropping against our ships on this occasion, but dive bombing and other tactics were adopted. None of our ships was damaged and we suffered no casualties. The enemy, however, appears, from reports received from neutral countries, to have lost four or five machines which had been damaged by our fire and which had to come down before they could reach home. During the attack on the Firth of Forth on Monday, carried out by about a dozen enemy aircraft, no serious damage was done to any vessel or work, but some casualties were caused by bomb splinters, three officers and thirteen naval ratings being killed. At least four of the enemy's machines were brought down. As regards the enemy's efforts to destroy merchant shipping, no use has been made of direct aerial attack. Reliance has been placed on submarine warfare for this purpose, with results that are well known. During the first week of the war, from September 3rd to 9th, we lost 65,000 tons of merchant shipping by submarine attack. The second and third weeks showed a rapid diminution, and during the sixteen days from September 24th to October 9th, our total losses amounted to only 5809 tons. Doubtlessly much credit for this result should be given to the ships of the Royal Navy, but the Royal Air Force and the Fleet Air Arm have certainly contributed something towards it. During the first four weeks of war our aircraft sighted enemy submarines on 72 occasions and delivered 34 attacks against them. Some of these attacks were undoubtedly successful. Moreover, from the evidence obtained from prisoners, it is certain that the mere presence of an aircraft, whether on patrol or accompanying a convoy, is sufficient to induce a submarine to submerge and to remain submerged.

In one other important respect the actual course of the war has upset certain confident prognostications. It was freely asserted as a result of experience in Spain that the German anti-aircraft equipment had reached a formidable stage of efficiency, and that the events of the last war characterised, for the most part, by a low standard of performance on the part of the anti-aircraft guns and their adjuncts then available, would provide no manner of guide as to what we might expect in the next conflict. In certain attacks against the enemy's fortified bases our aircraft have, undoubtedly, encountered efficient defence, and have suffered casualties from accurate shooting. On the other hand, our aircraft have repeatedly carried out over Germany long reconnaissances and leaflet-dropping raids—some of them involving flights over 1000 miles in length, and reaching as far as Berlin and Potsdam—without serious interference and without loss. Even within the area of military operations on the Western Front, British and French aircraft have found it possible to carry on their work with remarkable immunity and success. The whole of the Siegfried Line has been photographed from the air, parts of it from a height of only a few hundred feet, and a complete map of it is now available. On one occasion some of our reconnaissance aircraft flew along the whole frontier of Germany from the Saar to the North Sea without material hindrance, and then proceeded to Heligoland before returning to their base in England.

It may be that in all these respects, political rather than military considerations have, so far, dominated the war, and that our all but complete immunity from air attack is a result of the enemy's policy rather than of his inability to engage in it. If that policy changes we may experience an attempt on the "home front" from the air, but we can await that possibility now with far greater equanimity than a year, or even a few months ago. From September, 1938, to September, 1939, we were not idle, but the past six weeks of peaceful war conditions have enabled us to complete our preparations in a manner which will enable us to give any raiders a somewhat warmer reception than that accorded to our aircraft in their flights over Germany up to the present. It may be, too, that our defeat of the submarine menace should not be regarded as wholly permanent and final. We may yet have to meet another wave of attack, and the renewed sinkings of the past few days may herald it. But it is certain that the experience we have gained and the increasing means of meeting the danger now becoming available will enable the Navy and the Air Force eventually to defeat the enemy's effort on, under, or above the sea.

On the material side of the war in the air Sir Kingsley Wood, in his review of the work of the R.A.F. during the first weeks of the war, outlined, in the House of Commons on October 10th, a position which can be accepted as satisfactory. The alleged superiority of German aircraft has not been demonstrated as yet, and there seems to be no reason to believe that the German aircraft industry is better organised and able to produce larger numbers of efficient machines than our own and France's. It would, in fact, appear that we are now about to reap the benefit of the policy—a policy which we have advocated and supported from the days of the last war—that true wisdom lay in our providing the means for the rapid expansion of aircraft production in war time rather than in the provision during peace time of an Air Force strong merely in numbers. During the twelve-month twilight of war which preceded its declaration we built up a rate of aircraft production which, it is said, equalled that of Germany towards the end. Immediately following the outbreak of the war our preparations for increasing the output were put into force and we have Sir Kingsley Wood's assurance that in due course our production of aircraft will expand to more than twice its present figure. One wonders whether the German aircraft industry, hard taxed as it was before the war and now cut off from certain essential supplies of raw material, will be able to follow suit. If it does not do so the end, although it may be delayed, is certain.

Although our proper field as an engineering journal is with the material rather than the personal side, a review of the war in the air would leave much unsaid if it failed to mention the steps being taken to increase not only the number of aircraft at our disposal but also the inflow of pilots, observers, gunners, and others required to operate them. On the occasion referred to above, Sir Kingsley Wood revealed the initiation of a scheme which, if it is as effective in practice as it is inspiring in an imperial sense, will ensure to us a recruitment of men for the air services which should prove the knell of any dream of aerial supremacy which the enemy may have. In Canada, Australia, and New Zealand recruits are to be given their preliminary training in large numbers. Thereafter they are to proceed to Canadian training grounds, where they will meet correspondingly trained recruits from this country. Canada, by reason of its geographical configuration and by its remoteness from possible air attack, offers an exceptionally suitable locality for completing the advanced training of air recruits. When they have been fully prepared they will be drafted either to the Air Forces of their own countries or to the Royal Air Force. In addition to supplying recruits—and from past experience we know the qualities of the pilots furnished by the Dominions—the countries of the Empire are increasing to the limits of their capacity their production of aircraft. It is not impossible to see a connection between this overseas source of aircraft supply and the selection of Canada as the centre of advanced training for our future airmen. The Dominion of South Africa, for reasons which are no doubt sound, and which may partly be guessed, will also take part in the increased production of aircraft, but will undertake the preliminary and advanced training of its pilots within its own territory.

The account which can thus be given of the first weeks of the war in the air is encouraging to a degree which, at one time, would have been almost unbelievable. While we may express our thankfulness and a sense of relief at the course which it has so far followed, we must avoid falling into complacency and assuming that the position as at present revealed is stable. To do so would be to play into the enemy's hands, possibly in the very way which he subtly intends. Certainly, some of the features of the situation are mysterious and hard to explain. We must not,

however, allow ourselves to be lulled into a sense of false security. In the air the advantages in the long run are overwhelmingly on our side. There is just a danger that at this stage we may jeopardise them by attributing to the enemy less ability and enterprise than we were led to believe he possessed. The time has not yet come when we can safely say that we are masters of the air. It undoubtedly will come, but for the moment it is our duty to remain watchful, to maintain and increase our efforts, and to guard against all possible surprises on the part of an enemy known to be resourceful of expedient, and cunning in execution.

Obituary

DR. JOHN HENRY TUDSBERY TUDSBERY

Those of our readers, both at home and abroad, who have been associated with the Institution of Civil Engineers for the past forty years, will hear with regret of the death of Dr. J. H. T. Tudsbery, which took place at his home, Thanet House, Emsworth, Hampshire, on Tuesday, October 10th. Dr. Tudsbery, who was eighty years of age, was secretary of the Institution of Civil Engineers from 1896 until 1922, and held office as honorary secretary until his death.

He was the son of the late Mr. William Tudsbery Turner, and assumed the patronymic Tudsbery by Royal Licence in 1894. He was born in Cheshire at Storeton in 1859, and received his education at the Birkenhead School, and his technical training at Glasgow, where he had a distinguished career at the University as medallist and prize-man, and later obtained the Degree of Doctor of Science. On leaving Glasgow he was articled to the late Mr. G. F. Deacon, LL.D., M.Inst.C.E. After spending some time at the Barrow Steel Works he was, in 1881, appointed assistant engineer in connection with the Vyrnwy Waterworks which were then being constructed on behalf of the Liverpool Corporation Water Department. A few years later he left for Japan and took up service with the Japanese Government, being employed on several civil engineering works and the scheme for supplying the city of Yokohama with water. He returned to England in 1887, and from that year until 1892 practised in Liverpool as a consulting engineer. To him belonged the honour of making one of the first engineering surveys of the Mersey estuary and carrying out appropriate hydraulic and other works.

During his Liverpool days he acted as honorary secretary of the Liverpool Engineering Society, work which prepared him for his appointment in 1892 as assistant to the late Mr. James Forrest, who was then secretary of the Institution of Civil Engineers. Four years later Dr. Tudsbery succeeded Mr. Forrest as secretary, and for the next twenty-six years he occupied that position with distinction, carrying on, it may be said, much of the Forrest tradition. During his term of office, the Institution advanced in many important respects. The most noteworthy of these was perhaps the gradual rise in the standard of education and practical qualifications required in those elected to its membership. During these years the Council made numerous efforts to secure a fuller recognition of the status implied by membership of the Institution, and these efforts owed much to the administrative ability of Dr. Tudsbery. He was also responsible for a great deal of the work which was entailed in removing the Institution to the distinguished home it now occupies in Great George Street.

On his retirement in 1922, when he was succeeded by the late Dr. H. H. Jeffcott, Mr. William Barton Worthington, who was then the President, paid a warm tribute to Dr. Tudsbery's work for the Institution, and for the Councils under which he had served. Dr. Tudsbery, he said, had not alone by virtue of his office, but on account of his sound judgment and foresight, been able to render valuable service to the Institution, both on the questions of policy and administration which were at the time engaging the Council's consideration, and subsequently when the changes which were thus introduced were put into practice. He contributed in a marked degree to the maintenance and development of the essential objects of the Institution as defined in the Royal Charter. The Council on his retirement put on record its high appreciation of the devoted service he had rendered during his long term of office.

He contributed three papers to the Institution, one dealing with "The Gauging of Flowing Water," some "Notes upon Useful Japanese Timbers," and "The Construction of the Yokohama Waterworks." He was also joint author with Mr. A. W. Brightmore of a standard treatise entitled "The Principles of Waterworks Engineering." He was well known in scientific and engineering circles both in this country and overseas, and was an Honorary Member of the Institution of Royal Engineers, the Koninklijk Instituut van Ingenieurs of Holland, and the Liverpool Engineering Society.

We have said that Dr. Tudsbery carried on the James Forrest tradition; a tradition which has been described as "high-mightiness." For that he was censured a good deal in his day; but it is only fair to him to recall that he only reflected the attitude of the Council in that period—a period when dignity and the observance of etiquette were more highly considered than they are to-day. When Dr. Jeffcott took office a change was already beginning. Some of the older members of Council belonged to the rigid, superior school, but the

DR. J. H. T. TUDSBERY

younger men saw that a more sociable standpoint between the secretary and the members had become desirable, and the new secretary brought with him a change of atmosphere which has remained ever since to the satisfaction of the members.

BRIGADIER-GENERAL H. A. BETHELL

The death of Brigadier-General H. A. Bethell, R.A., is of particular interest to us as he was, for several years, our special correspondent on Artillery and kindred subjects. His articles were not signed, but the hand of the expert is evident in them. One in especial may be mentioned, not only because it was the last he wrote for The Engineer, but because it dealt with a subject very much in everyone's mind then just as it is to-day. It described Krupp guns, and was printed in our issue of September 25th, 1914, under the title "The Enemy's Gun." Soon afterwards, Colonel Bethell, as he was then, went to France where he was appointed Brigadier-General; subsequently, he was mentioned in despatches, and in 1918 was created C.M.G.

He was born at Bath in 1861, was educated at King's College, London, and entered the Royal Artillery in 1880. After serving for a number of years in India, he returned to England and in 1911 retired. He was the author of two well-known books, "Modern Guns and Gunnery," and "Modern Gunnery in the Field," both written before the Great War. He also wrote articles for the British Encyclopædia, was a Member of the Howitzer Committee and the Artillery Committee, and was awarded the Lefroy Medal in recognition of his services to artillery science.

OSCAR HARMER

Machine tool makers and users all over the world will hear with regret of the death of Mr. Oscar Harmer on October 11th. He might be regarded, justly, as the doyen of that industry, for he had reached the great age of ninety years, for the last forty-two of which he served with Alfred Herbert, Ltd., becoming ultimately general manager and a director. His early life was spent in the United States where he worked for a number of the leading machine tool makers. He came to this country to instal and operate the plant of the Capewell Horse Nail Company at Millwall, where he introduced many ingenious automatic machines. He was later asked to join the Babcock and Wilcox Company to re-organise its plant and methods of production. In several strenuous years he laid out and equipped the works at Renfrew designing many special machines for manufacturing parts of the Babcock boiler. In January, 1897, at the invitation of Sir Alfred Herbert, Mr. Harmer joined the firm of Alfred Herbert, Ltd. He introduced the practice of visiting engineering establishments where he studied their work, obtained samples, quoted for machines and tools for their production, gave schedules of operation and guaranteed production times, and undertook to accept orders for the machines and tools on condition that the guarantees were fulfilled. This method of offering machines, which was at that time but little known to the engineering industry, proved very successful, but entailed a lot of hard work. Mr. Harmer often found it necessary to work all day, travel all night, spend the next day interviewing customers and obtaining their samples, and returning to Coventry the next night. He will be missed by his colleagues and by a large circle of friends.

Sixty Years Ago

The Wortley Ironworks

In the course of a paper entitled "On the Strength of Wrought Iron Railway Axles," read by Mr. Thomas Andrews before the Society of Engineers and reproduced in our issue of October 24th, 1879, some particulars of the Wortley Ironworks, near Sheffield, stated to be "about the oldest ironworks in the United Kingdom," were given. As evidence of the antiquity of the works an inscription on a tombstone in Wortley Churchyard was quoted. "Here lies," it ran, "the body of Francis Askew, of Upper Forge, hammerman; died 24th October, 1669." The best charcoal iron had been made at the works ever since 1660 and even earlier. In 1713 the works were enlarged and improved and towards the end of the eighteenth century they were operated by Mr. James Cockshutt, F.R.S., a civil engineer and a partner of Richard Crawshay, the great South Wales ironmaster. It would appear that the process of rolling puddled blooms by means of grooved rolls was put into practice almost simultaneously at Wortley and at Cyfarthfa. This process superseded the method of forming bars by means of forge hammers. In a letter from Wortley dated April 17th, 1812, addressed to Mr. Coningsby Cort, James Cockshutt made it clear that the recipient's father, Henry Cort, was without doubt the inventor of the process of rolling bars from blooms by the use of grooved rolls as well as of the process of making iron by puddling. Cockshutt stated that in June, 1787, he and Richard Crawshay had seen a demonstration at Fontley of Cort's puddling process and of his method of rolling blooms into bars and that the demonstration had so impressed them that they decided to adopt Cort's ideas at their ironworks. The letter denied all credit for the invention of the rolling mill claimed by or for Homfray who, it was stated, had been given permission to copy the construction of the Cyfarthfa puddling furnaces and rolling mills, being assisted in that respect even to the extent of being allowed to borrow the patterns used in the construction of the mill. Had Crawshay not been convinced of the justice of Cort's claim he would not, Mr. Cockshutt concluded, have consented to pay him 10s. per ton for patent rights. In the further course of his paper Mr. Andrews outlined the means employed before the days of the railway of conveying the products of the works to Manchester, Halifax, Bradford, and other towns. At first the transport was effected by pack horses journeying across the moors. When turnpike roads were constructed the pack horses gave place to wagons. Some of the paths used in those early days were still in existence in 1879 and the stables in which the horses were housed, converted later into workmen's cottages, were still standing. At times of dry weather when the water in the river and dams was low, as many as a dozen carts might be seen waiting at the works for several days for the orders to be executed. The first railway axle was made at Wortley in 1838 and it was considered a great achievement to be able to make two or three axles per day under the old hammer, dating apparently from 1713. The works were remodelled in 1855 and again in 1868, and at the date of Mr. Andrews' paper were capable of turning out 250 to 300 railway axles per week.

The Mercantile Marine of U.S.S.R.—A new register of shipping of the U.S.S.R. shows that the country has 303 ships of between 1000 and 5000 tons, and 33 of between 5000 and 8000 tons.

Projected Exhibits at Olympia

No. VI

(*Continued from page* 383, *Oct.* 13*th*)

BELOW we continue our description of some of the exhibits which were to have been shown at the Engineering and Marine Exhibition at Olympia, London, the holding of which has had to be postponed on account of the war.

The Rapid Magnetting Machine Company Ltd.

Following its usual practice, the Rapid Magnetting Machine Company, Ltd., of Magnet Works, Lombard Street, Birmingham, was to have shown a selection of magnetic separators of various types, lifting magnets, magnetic clutches, chucks, &c. A new feature in connection with some of the

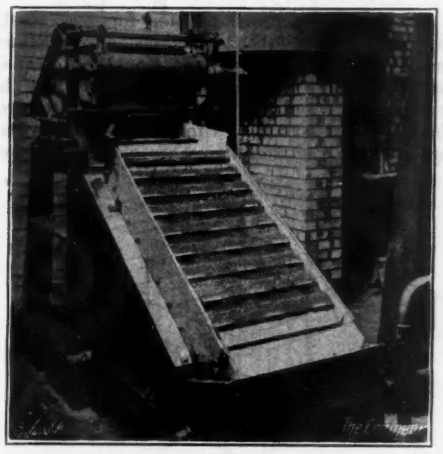


FIG. 136—ELECTRO-MAGNETIC PERCOLATOR—RAPID MAGNETTING

firm's designs is the introduction of separators and chutes embodying permanent magnet units of great lasting strength. While the use of these permanent magnet separators has its limitations and for a number of jobs they cannot be used so successfully and efficiently as high-grade electro-magnets, they give a high efficiency of extraction on the work for which they have been designed. These permanent magnet equipments are applied to the firm's smaller designs, such as for scrap sorting and small chutes for use in grinding mills, &c. For dealing with certain grades of non-ferrous swarf

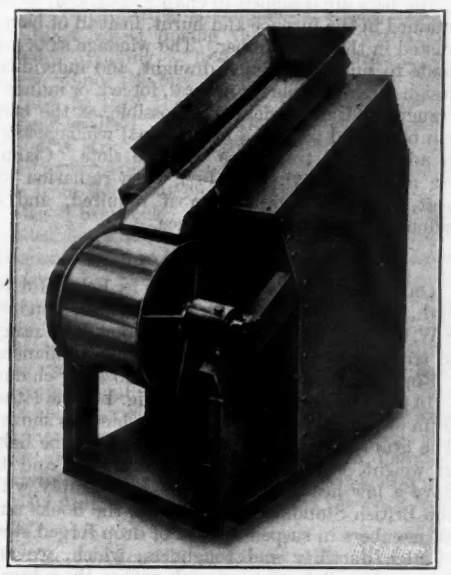


FIG. 137—"BIAFLUX" DRUM SEPARATOR—RAPID MAGNETTING

and borings, &c., the drum pattern permanent magnet is offered, which is similar in appearance to the firm's "J" type electro-magnetic separator. Other types of drums and certain sizes of magnetic pulleys incorporating these permanent magnet units are supplied. In the latter category there was to have been shown a permanent magnetic pulley of interest to foundrymen and others, in view of the fact that no subsidiary apparatus in the form of a rectifier or motor generator set is required. In the design of these permanent magnet units the firm is working in conjunction with the permanent magnet manufacturers, Darwins, Ltd., of Sheffield.

A new and improved design of electro-magnetic separator for the extraction of fine iron particles from liquid such as Potter's slip glaze, enamels, and oils, was to have been shown for the first time. This is the "Rapid" electro-magnetic percolator, and whilst the principle of the magnet is the same as that of the original chute type magnets placed on the market by the firm thirty years ago, it embodies entirely new features and is claimed to be a definite advance on anything on the market. The machine is illustrated in Fig. 136. The Potter's slip is fed on to the separator *via* a vibrating sieve mounted on top of the apparatus.

Other exhibits were to have been the firm's "Rapid" multi-unit self-cleaning chute type separator, which is said to be the fastest and most efficient separator for the extraction of loose iron and steel from non-ferrous swarf, borings, &c., and the "Biaflux" electro-magnetic drum, shown in Fig. 137. The self-contained machine has a vibrating feed tray, which, if necessary, can also be fitted with a hopper and immediately underneath and totally enclosed to exclude sand and dust is fitted a driving motor and a D.C. generator. This machine is particularly suitable for the treatment of foundry sands, &c., and when necessary can be arranged in portable form.

An exhibit of exceptional interest to those connected with foundries, steel works, &c., was to have been an electro-magnet operating on an electro hoist for demonstrating its application to pig iron scrap, steel bars, sections, &c.

Stream-Line Filters, Ltd.

Most of our readers are already familiar with the principle upon which the "Stream-Line" filter works. It consists essentially of forcing liquid by pressure or drawing it by vacuum through columns built up of specially prepared paper discs held tightly together. The liquid

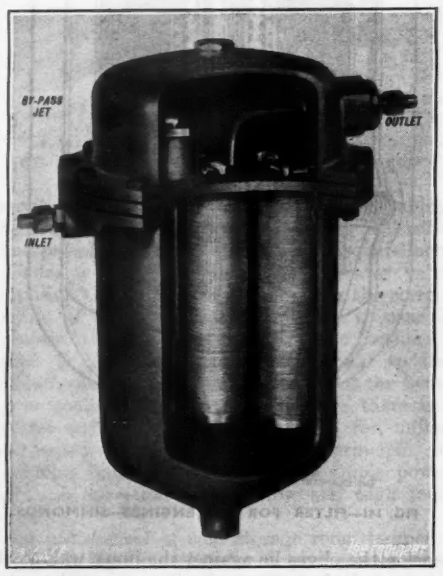


FIG. 138—FILTER FOR USE ON MOTOR VEHICLES—STREAMLINED

passes through minute passages caused by the inequalities of the paper surfaces and leaves any suspended dirt on the outer surface of the columns. Each filter pack is mounted on a square rod, which serves as a compression bolt for the paper discs. Spaces formed between the sides of the rod and the circular hole through the pack of paper discs form passages for the cleaned liquid to the filter outlet chamber. Deposit caked on the outside of the pack is easily and rapidly removed by a reversal of the liquid flow.

A full range of filters for the purification of used engine and insulating oils was to have been shown on the stand of Stream-Line Filters, Ltd., Hele-Shaw Works, Ingate Place, London, S.W.8. One of particular interest is that shown in Fig. 138, which has been designed for use on motor vehicles.

This filter is incorporated in the lubricating oil circuit of the engine, and through it a portion of the oil is continually passed. It is not considered necessary to pass the full flow of oil through the filter and by the adoption of a by-pass principle there is no tendency to restrict the supply of lubricant to the bearings as the filter has no influence on the main circulation except to ensure that it is clean.

The inlet of the filter is connected to the pressure side of the engine oil circulating pump, and the inlet pipe opens into an annular passage round the upper part of the lower or filter chamber. A narrow passage between the chamber wall and the groove permits a steady flow of oil down the side of the chamber. This steady flow prevents any turbulent effect likely to stir up sludge at the bottom of the chamber.

Pressure set up by the incoming oil forces liquid through the filter packs and up into the discharge chamber. In order to prevent the flow of oil through the filter vessel from being impeded at the commencement of operations by the relatively high viscosity of any cold lubricant left in the lower chamber a by-pass is arranged between the two chambers. This by-pass is in the form of a jet and non-return valve, in parallel with the filter packs, which permits a flow of unfiltered oil to the upper or outlet chamber with sufficient rapidity to ensure that the incoming hot liquid will quickly fill the lower chamber. The jet of the by-pass is sufficiently small to restrict the flow of the oil so that it will not be detrimental to the engine.

The outlet pipe from the upper chamber is arranged with its mouth near the bottom, and this, coupled with a certain amount of back pressure, set up by a spring-loaded outlet valve, causes an air lock to be formed in the chamber when the apparatus is working. When the engine stops and the oil flow ceases, the air cushion expands to force oil back through the filter packs, and so remove any accumulated solids from their outer surface. The solids form a sludge which is removed periodically through the drain at the bottom of the filter chamber.

Simmonds Aerocessories, Ltd.

A wide range of the products of Simmonds Aerocessories, Ltd., of the Great West Road, Brentford, London, were to have been shown at the Exhibition. The Simmonds elastic stop nut, claimed never to work loose, is largely used by aircraft manufacturers. This nut is a standard nut with its height slightly increased so as to enable a fibre collar to be inserted in an annular groove. The collar is not threaded and has an internal diameter slightly less than the diameter of the bolt. When the bolt has passed through the threaded portion of the nut it makes its own thread through the fibre collar. As a result of the elasticity of the material of which the collar is composed, the threads are not actually cut by the bolt, but the material is pressed aside, causing friction between the threads. In addition, the tightening of the nut causes the nut to be pressed in an upward direction, as shown in the accompanying engraving, Fig. 139. It is claimed that on a $\frac{3}{8}$in. bolt the

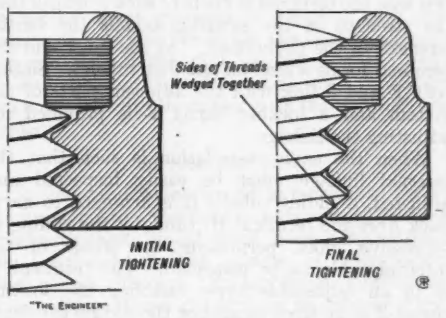


FIG. 139—ELASTIC STOP NUT—SIMMONDS

axial force amounts to about 700 lb. This force distributes itself as a pressure on the underside of the bolt thread, the side of the thread which, when the nut is tightened, carries the normal load. The friction exerted thus causes a considerable anti-rotational force if the nut should tend to turn. Consequently these nuts are of use wherever vibration occurs and where previously a locked nut has been required.

The Simmonds-Corsey transmission system, also to have been shown on the stand, is a push-pull system, capable, it is claimed, of transmitting loads over considerable distances with efficiency. It is applicable to a number of uses, particularly for motor car and aircraft control operation.

The system in its most elementary form comprises a series of "olives" and "tubelets"

threaded alternately on a flexible steel cable. The olives have female hemispherical ends and the tubelets male hemispherical ends, so that a ball and socket joint is obtained, without slackening or tightening of the cable as it bends. This linkage is inserted in an outer casing tube of internal diameter slightly greater than the external diameter of the olives. The tube can either be bent to any desired shape or it can be of flexible construction. Tubing suitable for bending can be supplied in almost any material, though brass and light alloys are most usual. Finally, into each end of the casing tube is inserted a rod or tube suitably constructed for attachment to the linkage, and finished off at the outer exposed end in any manner suited to connect up with the adjacent members of the system.

The method adopted for attaching the sliding rods to the linkage and the details of the ends of the linkage itself are of importance. Four different designs are utilised to meet varying requirements. Referring to the drawing reproduced in Fig. 140, A indicates the external casing, B the steel olive, loosely threaded on special steel cable, and C the tubelet. At D is shown the terminal, externally

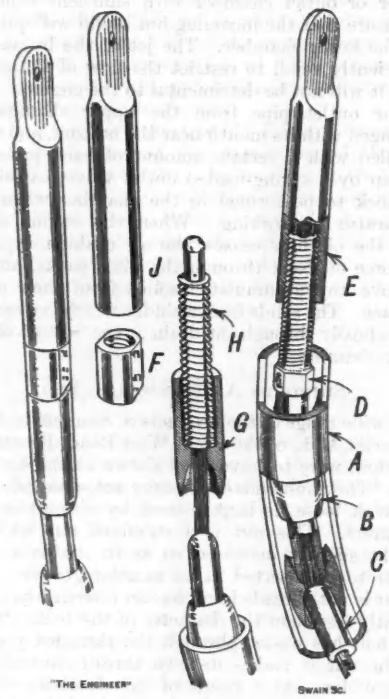


FIG. 140—SIMMONDS-CORSEY TRANSMISSION SYSTEM

threaded and swaged on to the cable under such pressure that the terminal becomes, it is stated, structurally unified with the cable itself. Where loads are relatively small and economy is required, the terminal can be soldered to the cable, but in this case the terminal is made of such a length that the strength of the sweating equals the tensile strength of the cable itself. At the inner end the terminal forms a seat for the first tubelet. Sliding rods E and J link with the adjacent parts of the system and a locking barrel F is provided for adjusting the linkage.

When the cable installation is such that the internal linkage must be easily inspected and adjusted, a sliding tubelet G is arranged to move back over the terminal H, thus, by the sliding of successive links, permitting the whole of the internal cable to be inspected. The terminal H is of an adjustable type, enabling the locking barrel F to be screwed against the sliding tubelet G until any axial play in the linkage is eliminated. The sliding rod J is screwed against the locking barrel. The non-adjustable end of the linkage is always inserted into the casing tube first, so that it is impossible to disturb the selected tension whilst passing the linkage into the tube. Inspectable units thus permit the whole of the internal linkage to be readily inspected and adjusted.

Where the function of the unit is not one of primary importance, a slight economy is effected by omitting the sliding tubelet G and thus permitting the end olive to butt against the locking barrel F. The linkage can then be adjusted in length to compensate any slight stretching in the cable, but the cable cannot be inspected without breaking the linkage by detaching one of the terminals D or H.

Where loads are light and the function of the unit is of secondary importance, both terminals can be of the non-adjustable type D. This arrangement permits the linkage to be withdrawn from the casing tube for cleaning, but it is neither possible to adjust its length nor to examine the cable.

In the fourth type of linkage connection, known as the permanent type, the screwed terminals are dispensed with and the sliding rods are attached directly to the cable. Except, therefore, when the casing tube is flexible or straight, the linkage cannot subsequently be withdrawn without breaking it down. This type of unit is designed for use where economy is of the greatest importance.

Frictional loss, backlash, and wear are claimed to be very small for the Simmonds-Corsey transmission. On straight portions the friction is negligible and on a 60 deg. bend in tension the loss is stated to be about 10 per cent., and in compression about 15 per cent.; round a 90 deg. bend these losses become respectively about 13 and 18 per cent. We are informed in this connection that units more than 40ft. long, containing nine right-angled bends, have been supplied with satisfactory results. In connection with wear, a test showed that after a million reversals against a constant frictional load the total axial play in a linkage consisting of fifty olives and tubelets was 0·036in. This play between the olives is stated to have no effect on the running or failing load of the control. Of this wear, the major part was caused by bedding down, as the sample chosen was entirely new, and a continuation of the test beyond the first million reversals indicated that the increased wear per million reversals does not exceed 0·012in. The wear, of course, can be taken up at any time.

The end play or backlash is also claimed to be very small. A small clearance between the outside of the olive and the inside diameter of the casing tube is clearly essential. When the unit is in

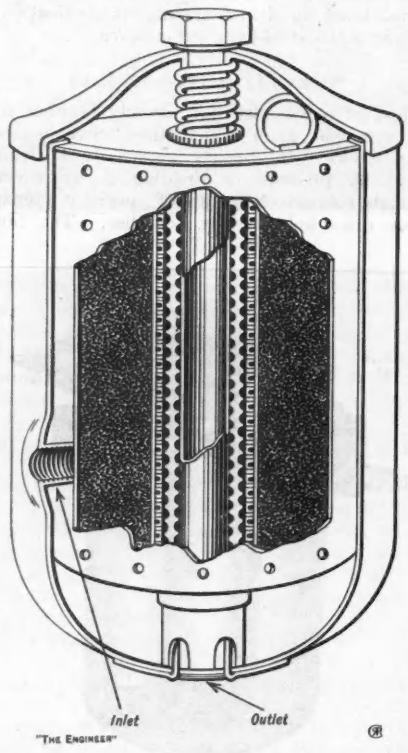


FIG. 141—FILTER FOR I.C. ENGINES—SIMMONDS

tension the olives lie against the inner wall at the bends, and when in compression against the outer. On a production basis, it is reasonable, the firm considers, to assume about 0·007in. backlash for each 90 deg. bend, although closer limits can be specified. It should be noted, however, that any play which may develop among the components of the linkage cannot result in increased backlash, the only cause of which must be increase in the tolerance between olive and casing tube.

As regards lubrication, on short units of small diameter the provision consists of an oiling hole in the casing tube protected by a spring clip. On larger or longer units lubrication nipples are mounted on the casing tube itself if they are there entirely accessible, or, otherwise, a short tube is taken from the lubricating union to a nipple fixed at the nearest convenient point.

We illustrate in Fig. 141 a new oil filter designed for use with internal combustion engines. The filter works on the by-pass system, and is claimed to strain out abrasives and colloidal particles, and by means of a chemical action to eliminate excessive acids. The filter, known as the Simmonds-Fram oil and engine cleaner, is made in four sizes, suitable for use with private cars or commercial vehicles. Oil is forced through a tightly packed roll of straining material impregnated with a chemical compound which is claimed to remove fine particles of carbon, partially oxidised portions of oil, acids, and other chemical impurities. A novel idea is that with each filter the firm supplies what is termed an "oil condition gauge" to attach to the dipstick. If the word "clean" marked on this gauge cannot be seen because the oil on the dipstick is dirty or dark in colour, it is time for a renewal filtering cartridge to be placed in the oil cleaner.

Other exhibits to have been shown included a Simmonds jointing compound, claimed to be non-hardening and heat resistant up to 400 deg. Fah., the firm's cowling clips for aircraft use, and the Simmonds-Goudime navigation instruments. To the last named we have previously made reference in these columns.

Collins' Improved Firebars, Ltd.

A new design of fire-bar for furnaces would have been shown at the Exhibition by Collins' Improved Firebars, Ltd., of 24, West Street, Scarborough. The construction is shown in the accompanying engraving, Fig. 142. The firm claims several advantages for the special design; for example, the side strips are claimed to give

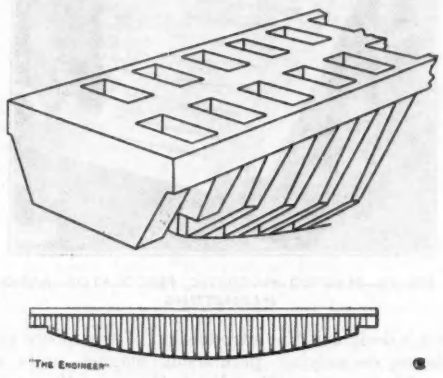


FIG. 142—DESIGN OF FIRE-BAR—COLLINS

lateral strength and protect the edges of the projecting teeth from burning. Since the bars are contiguous throughout their length, warping cannot occur, and the design also enables increased air space to be given at the bearing ends without weakening the bars. Furthermore, the increased air space is said to keep the bars cooler on the underside, so preventing their burning.

The bars are designed to enable small coal to be retained in the furnace and burnt, instead of being wasted in the air chamber. The windage slots are made to suit the fuel and draught, and individual designs are available for natural, forced, or induced draughts. Under-pricking is possible, as the bars can be spaced to give a longitudinal windage slot, in addition to transverse windage slots. Claims are made for savings in fuel, even radiation of heat, increased evaporation if required, and a reduction in the smoke nuisance.

Felco Hoists, Ltd.

On the stand to have been taken by Felco Hoists, Ltd., of 17, Victoria Street, Westminster, London, S.W.1, would have been shown a complete range of triple-gear chain blocks and lifting appliances, "Ropelock" rope pulley hoists, and sling chains.

In the drawing reproduced in Fig. 143 the latest form of the firm's triple-gear chain block is shown. The firm states that they are designed to be light in weight, self-sustaining, and compact, and to have a low headroom. Designed to comply with the British Standard Specification, the hooks and all members in suspension are of drop forged steel of high ductility and toughness, which, we are informed, will tend to stretch rather than break under severe overloading. The chains likewise are of ductile steel, formed, welded and heat treated, so that they will stretch under heavy intermittent loads, thus giving warning of any danger.

Gearing for the hoisting mechanism is arranged in a planetary fashion (Fig. 143), giving, it is claimed, balanced tooth pressure and low bearing pressures. The gears are mounted on case-hardened and ground steel bearings. The hand wheel is a steel stamping, which is claimed to be unbreakable, and the load wheel or sheave is of aluminium bronze, produced to form the correct generated profile for the chain link pockets. This material

is said to be stronger than steel and to be particularly immune from fracture caused by shock and alternating stresses. Furthermore, the design of the chain link pockets gives a full area of contact to the chain links, thus minimising abrasion and wear.

When lowering a load, a screw-actuated disc type brake comes into action, the braking effect being proportional to the suspended load. The screw for its operation is carefully designed with a special helix angle, so that a smooth action and easy release without snatching is obtained. Moulded asbestos, a material which will not swell when

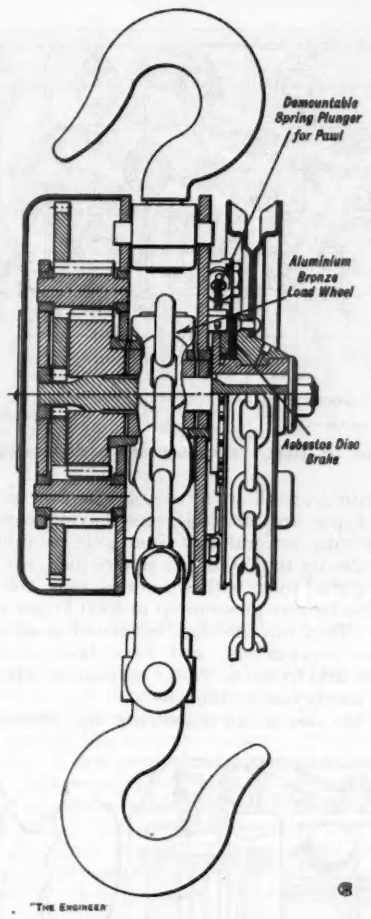


FIG. 143—TRIPLE GEAR CHAIN BLOCK—FELCO

damp, is used for the brake disc, so that the block can be operated in wet and underground situations. A pawl controlled by a compression spring engages a ratchet wheel during the lowering operation, thereby applying a braking effort through the screw. Since the pressure developed by the pawl, tending to turn the ratchet, is exerted by the suspended load, the braking or self-sustaining action is strictly proportional to the load. The small amount of head room required can be readily seen from the arrangement drawing.

The "Ropelock" pulley hoist, as its name implies, has a locking action on the hauling rope. As soon as the pull on this rope ceases, it locks instantly by means of a movable tongue which is automatically brought to bear on the rope. The arrangement is such that the heavier the load, the tighter the locking force. The tongue is shaped so as not to damage the rope. To lower the load the rope is pulled in a downward direction, and then held in towards the bottom block. The load can then descend freely, but can be checked at any point by holding the rope in an outward direction away from the lower block. The release action can equally well be effected by throwing the slack rope sideways.

Sarco Thermostats, Ltd.

Thermostatic controls for a variety of purposes would have been shown at the Exhibition by Sarco Thermostats, Ltd., of 28, Victoria Street, London, S.W.1. In Fig. 144 is reproduced a sectional drawing of the firm's automatic temperature regulator, suitable for application to all kinds of industrial heating systems, or cooling systems where a fixed temperature must be maintained. The regulator can be arranged to operate steam, water, brine, or gas valves, and can be supplied either to close or open the valve with a rise in temperature, or to operate a three-way mixing valve.

Referring to the engraving, A represents the thermostatic component, containing a temperature-sensitive liquid; a capillary tube B transmits the expansion of this liquid to a valve-closing element C, provided with a frictionless, leakproof gland for a piston D. The control valve E is provided with a spring F to reverse the movement of the valve when the liquid contracts. On the thermostatic element there is a regulating screw G and plunger H for temperature adjustment. In order to relieve accidental excess internal pressure, a "safety" spring J is fitted, upon which the plunger H acts. Within the thermostat tube A is arranged "Sarco" spiral bellows tubing, forming a seal for the oil system and eliminating all forms of gland packing.

It is pointed out that no stuffing-boxes are used in this arrangement. As the escape of even a minute quantity of oil would alter the whole setting of the control, it is impossible to employ a cylinder and piston of the conventional type, for the piston must be leakproof, capable of withstanding the high pressure involved, and at the same time must be frictionless. These conditions are claimed to be achieved in the arrangement

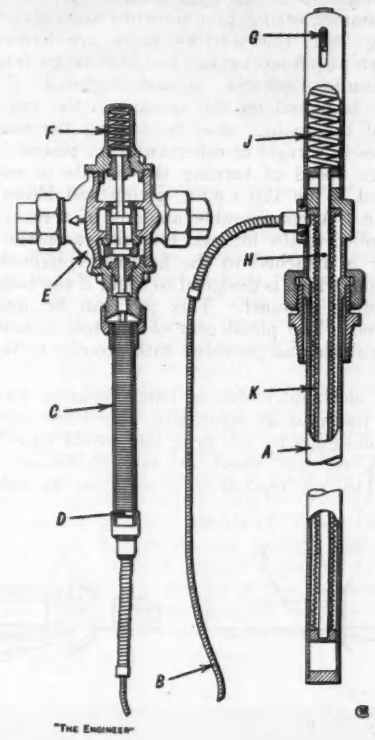


FIG. 144—A TEMPERATURE REGULATOR—SARCO

described, using spirally corrugated bellows tubing. The firm states that this type of tubing will withstand pressures in excess of 3000 lb. per square inch.

Under working conditions the regulator valve assumes a throttling position, allowing the correct amount of heating or cooling medium to pass to maintain the set temperature. The action is stated to be smooth and proportional to the demand, ensuring economy in the use of the heating or cooling medium. Furthermore, there is a positive and constant operating force, for, unlike the vapour-tension system, the principle of employing liquid expansion affords ample power for valve operation at both low and high temperatures.

For the control of cold storage room temperatures, this type of regulator is particularly suitable. The flexible connection between the thermostat and the valve makes it possible to install the thermostat in the most suitable position, regardless of the distance between the two. Other common applications are the control of drinking water cooling tanks, particularly in marine work, and the control of cooling circuits on air-conditioning plant.

A recent modification of the firm's regulator takes the form of a blender or mixing valve (Fig. 145). The system is basically the same, the elements previously described being built into a simple and compact unit. It is designed automatically to mix hot and cold water, brine, or other fluid, and deliver the mixture at any predetermined constant temperature between zero and 300 deg. Fah. It consists of a three-way valve with two ports for each inlet, all of equal diameter, so that the valve is fully balanced and operates regardless of pressure fluctuations between the two supplies. A represents the thermostat, B the spiral bellows, C the piston-rod, and D a plunger, the position of which proportions the hot and cold water entering the valve at inlets E and F, respectively. Blended water at the desired temperature is delivered at the outlet G. The temperature can be adjusted by the user over a range of approximately 50 deg. Fah. by rotating a screw H with a key. A relief spring J protects the thermostat against damage caused by accidental overheating up to 50 deg. Fah. above the calibrated temperature. A stop K can be provided to prevent the cold water valve being closed completely at any time.

Installed in reverse, to control cooling circuits, the blender proportions the flow in two directions according to the temperature. The normal outlet is connected to the return from the circuit, the valve then proportioning the amount which is recirculated and the amount which is passed through the cooler. It can be used in this fashion in connection with engine jacket cooling, brine refrigeration, and air-washer spray water.

A thermostat control for liquids heated by steam (Fig. 145) is also made by the firm. Known as the "Thermoton," the arrangement utilises the principle of liquid expansion employed in the controls described above, but is designed

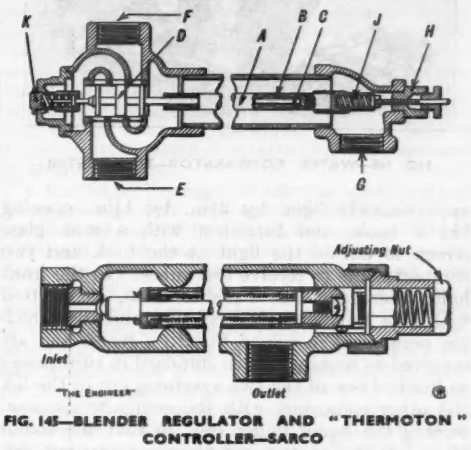


FIG. 145—BLENDER REGULATOR AND "THERMOTON" CONTROLLER—SARCO

to be an inexpensive form of steam saver and approximate temperature control for steam-heated water tanks and process plant. The steam valve is integral with a bronze body, which also contains a thermostatic element filled with oil and hermetically sealed with "Sarco" spiral bellows tubing. A simple means of temperature adjustment and a relief spring are provided in the head of the instrument.

In the case of small equipment heated by coil or jacket, and particularly in processes requiring a "simmering" operation after initial boiling, the Thermoton can be installed in the steam inlet pipe. The cooking boiler or other equipment is brought up to temperature through a by-pass, which is then closed by hand, the thermostat regulating the addition of sufficient steam to maintain the temperature desired.

For controlling the temperature of liquids heated by direct injection of steam, a tank connection is provided for fixing the control through the side wall of the tank or vat, and the body of the regulator is perforated so that the liquid can come into direct contact with the thermostatic element.

Tintometer, Ltd.

On the stand which would have been taken by Tintometer Ltd., the Colour Laboratory, Milford, Salisbury, there would have been demonstrated the Lovibond-Schofield system of colorimetry. This system employs the Lovibond Tintometer, British Drug House pattern, in its present form, but a mechanism is introduced inside the light cabinet which enables the relative brightness of the two fields of view to be modified at will, so that all colours can be matched by using not more than two of the three available series of red, yellow, and blue Lovibond colour slides. The setting of the mechanism varying the brightness of the two fields is read from a calibrated drum. The instrument readings obtained with this apparatus can, we are informed, readily be converted into the International units of colour adopted by the Commission Internationale de l'Eclairage in 1931. From a conversion graph it is possible to ascertain the dominant hue wavelength. The apparatus is very suitable for recording and standardising colours in the textile, paint, varnish, and other industries in which colours are used, and for metallurgical and other analyses.

Another projected exhibit is the Lovibond

"Comparator," a simple apparatus for measuring the pH of potable waters, boiler water, dissolved oxygen content of water, chlorine and phosphate contents, and so forth. In Fig. 146 we illustrate the "All-Purposes Comparator" in a case with the necessary accessory apparatus. This pocket instrument supplies a rapid and simple means of carrying out all colorimetric tests in which a series of permanent colour standards is required for comparison with the test samples. The apparatus consists of a black bakelite case, measuring

FIG. 146—WATER COMPARATOR—TINTOMETER

approximately 3¾in. by 3¾in. by 1½in., opening like a book, and furnished with a milk glass screen to diffuse the light at the back and two compartments to receive test tubes. In the front half, interchangeable bakelite discs, each fitted with nine Lovibond glass colour standards, which are permanent in colour, fit into a recess and are revolved as required: each standard in turn passes in front of one of the two apertures cut in the lid, the other coinciding with the compartment containing the liquid under test, so that the colour of standard and test sample are compared side by side. The value of the appropriate colour standard is read from a third aperture at the bottom right-hand corner.

The initial colour of the test sample naturally affects the colour developed in a reaction, so provision is made for a blank or untreated sample to be placed behind the colour standard when necessary, thus correcting for inherent colour, and extending the use of the instrument to coloured as well as water-white solutions. Space is provided for carrying two test-tubes, a pipette, and a small bottle of indicator or other appropriate solution inside the case.

THE RAWLPLUG COMPANY, LTD.

A complete range of fixing devices, including a number of new products, would have been shown by the Rawlplug Company, Ltd., of Rawlplug House, Cromwell Road, London, S.W.7. In addition to the well-known "Rawlplugs," new devices include an arrangement known as the "Rawldrive," consisting of a screw designed to be driven home by a hammer, and the screw anchor. The screw anchor is a metal device for exterior and interior fixing to brick, concrete, stone, and so forth.

We illustrate in Fig. H47 a new improved mechanical manually operated hammer, which is claimed to make the jumping of holes speedy and simple. Designed to use specially shaped drills, the hammer produces a jumping action by percussive action combined with a slow rotary drill movement. It is claimed that with the aid of this tool a hole 2in. long and ¼in. in diameter can be made in brick, stone, concrete, tiles, &c., in about half a minute. The hammer is operated by rotating the handle, and the power of the blow can be varied by means of an external adjusting screw.

Referring to the engraving, it will be seen that the hammer is provided with a mechanical movement having two four-throw cams A, giving, it is claimed, good balance. The cams are glass hard and take their drive from a shaft close to the main bearings; they act on the rocker arm B, pivoted about the spindle C. The upper end of the rocker arm is connected to the hammer block D and the lower end to a seating under the action of the compression spring E, the effect of which can be varied by means of the fly nut F. Also mounted on the cam spindle and rotated by the handle is a specially shaped cam G which engages with the twisting gear pinion H mounted on the hammer spindle J, and has the effect of slowly rotating the tool holder K. It is clear that the bit rotating motion is positive in action. By eliminating the spring pressure the hammer can be used as a slow-rotating drill.

In order to secure light weight and strength, the hammer casing is a pressure aluminium die casting. All the wearing parts are hardened. The percussion motion can be obtained by turning the handle clockwise, or anti-clockwise, if the handle is placed on the spindle on the opposite side of the casing, thus facilitating the making of holes in corners or other awkward places. The average speed of turning the handle is recommended to be 120 r.p.m., giving 480 blows per minute. A considerable amount of torsion can be applied to the bit, and for this reason the tool holder is attached to the hammer spindle by a cross pin which is designed to shear if the hammer is unduly strained. This pin can be quickly replaced. The pistol grip of the tool is covered with rubber and provided with grooves to fit the hand.

An electrically driven hand hammer for the same purposes as mentioned above has recently been designed by the firm, and would have been shown on the stand at the Exhibition. In Fig. 148 we reproduce a sectional drawing of this tool. Although particularly recommended for use in conjunction with Rawlplug fixing, the hammer is also claimed to be suitable for packing, pointing, and chase cutting. It has a capacity for holes up to ⅜in. diameter.

Blows are delivered by an ingenious mechanism consisting of two steel balls rotating within a cylindrical rotor under the control of a cam. The hammer unit is stated to be well balanced and to produce little vibration. Two blows are delivered per revolution, and the hammer unit rotates at 1500 r.p.m.; therefore, the number of blows is 3000 per minute. The cam, steel balls, and all wearing parts are glass hard. When the hammer is idling—that is to say, running without the drill being presented to a surface—the tool holder is automatically withdrawn from the percussive action, and the blows from the balls are cushioned so that no damage can be done to the tool holder or hammer casing. Furthermore, the tool holder is locked in position in the hammer and held clear until the drill is presented to a surface, consequently removing any danger of the holder being shot out. A tommy-bar is provided to effect the necessary rotation of the bit, and the tool holder is fitted with a rubber shield to prevent *débris* entering the tool holder guide.

The drive from the electric motor to the hammer is taken through two V-section canvas-backed rubber belts, giving a flexible drive and minimising shocks and vibration being transmitted to the motor shaft, thus protecting the life of the motor. The hammer casing is die cast in aluminium and has incorporated in the handle grip the switch for the motor. Compact in design, the motor runs at 4500 r.p.m., and is stated to consume 170 watts in continuous use. It is universally wound and suitable for D.C. or A.C. supplies.

E. GREEN AND SON, LTD.

Modern electric power stations and large industrial plants have in recent years adopted much higher working pressures, and in this connection E. Green and Son, Ltd., would have shown new designs of the "Premier Diamond" economiser, claimed to be particularly suitable for high pressures. This type of economiser is arranged with the tubes disposed horizontally,

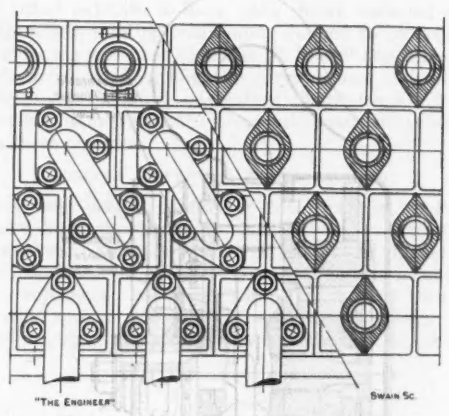
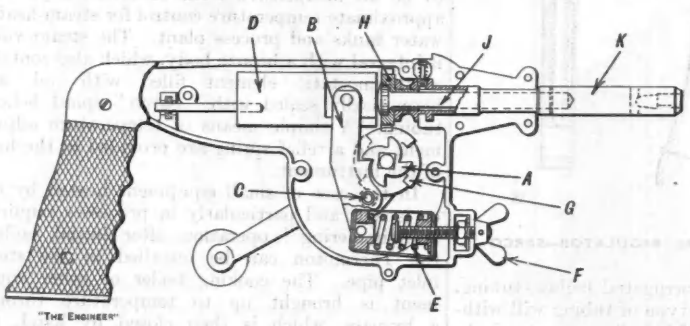


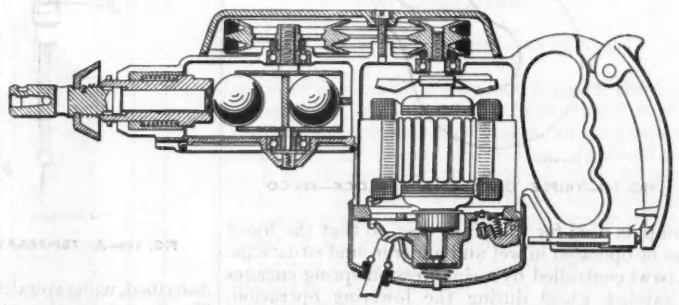
FIG. 149—FILLED ECONOMISER TUBES—GREEN

and with the gas flow downwards wherever possible. Two types are available, one having cast iron tubes with integral cast iron gills, suitable for pressures up to 650 lb. per square inch, the other having steel tubes with shrunk-on cast iron gills, suitable for any pressure up to 4000 lb. per square inch. They can therefore be classed as extended-surface economisers, and have been developed by the firm from the Foster economiser which has been widely used in the past.

In the case of an economiser the necessity for maintaining "plant availability"—that is to say, the ability of a boiler and its auxiliaries to run for long periods without being withdrawn from commission for cleaning or maintenance work—demands several considerations. For example, the heating surface must be of such a form that it possesses self-cleaning properties; the pressure joints must be immune from leakage, whatever racking stresses may act on the tubes during expansion and contraction, the tubes must be of sufficient thickness to resist internal pressure, and, if necessary, internal corrosion; they must be adequately protected against external erosion and corrosion; and, finally, when the plant does come down for overhaul the economiser should be of such a design that it can be thoroughly examined and dealt with in the shortest possible time. In all these respects the firm claims the new design to be improved.

In Fig. 149 is shown a cross section of a typical arrangement of "Premier Diamond" gilled tubes and in Fig. 150 is reproduced a photograph of the high-pressure type unit, composed of steel tubing with shrunk-on cast iron gills, showing a portion of a standard four-tube tier. The gilled sleeves are formed on a body which is roughly diamond-shaped, the gills being rectangular. This diamond shape approximates to the streamline form for a number of elements arranged in rows and tiers in staggered formation. The familiar blunt-nosed aerofoil section is, of course, the streamline form for elements remote from each other. It follows, therefore, that the gas streams pass over the heating surface without interruption,





FIGS. 147 AND 148—MECHANICAL AND ELECTRICAL JUMPING HAMMERS—RAWLPLUG

and, as there are neither dead spaces nor pockets, there can be no deposition of ash or grit. All portions of the heating surface are swept by the gases, resulting in a high rate of heat transfer; gas stratification is said to be impossible. The form of the gills has been designed to avoid the accumulation of dust, for the slope of the sides of the "diamond" is much greater than the angle of repose of flue dust, even under still conditions. With round tubes, whether gilled or plain, there is always a certain tendency for little mounds of dust to collect.

Another advantage gained by the use of a staggered diamond formation is that, whilst the gases

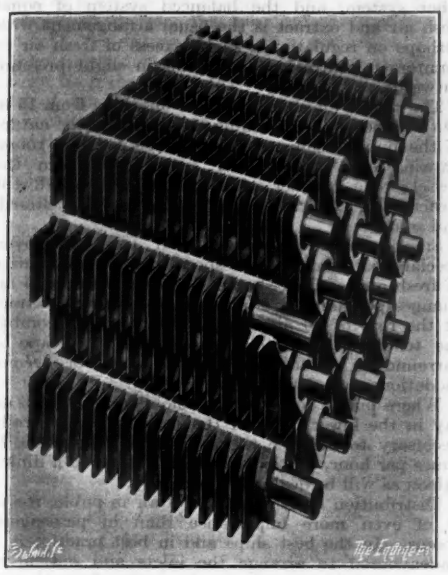


FIG. 150—HIGH-PRESSURE ECONOMISER—GREEN

are compelled to take a sinuous path through the economiser, the diagonal passages between the gills enable thorough inspection to be made of every part of the external surface. Particularly in England is this point of value, for the Factories Act of 1937 requires all parts of steam raising units to be capable of thorough inspection.

Each tube is independently supported at each end in machined cast iron gastight gland boxes, and at intermediate points when necessary. Freedom is thus provided for expansion and contraction. Any tube can be removed lengthways, and sideways withdrawal can also be arranged.

By reason of the greatly increased heating surface obtained with gilled tubes, a saving in space is obtained. In the design advantage could be taken of this fact by compressing many tubes in a small space, but the firm prefers to arrange an economiser in a series of relatively shallow banks, enabling deep spaces to be left between the banks. In this way, by leaving a space of 2ft. 6in. or 3ft. the banks of tubes can be readily inspected, and time saved. A typical arrangement, showing this space clearly, is shown in Fig. 151. This view is of a cast iron economiser with the casing open, showing the bends and connecting pipes, and an arrangement of travelling steam-jet soot blower.

Adjacent tubes are connected by solid-drawn steel return bends, and in the cast iron design, the joints are made between machined flange faces, no studs being used. It is claimed that on test these joints have withstood a hydraulic pressure of more than 7000 lb. per square inch.

In the steel tube with shrunk-on cast iron gills design a new and interesting type of self-sealing joint is used. Its construction can be seen in the engraving, Fig. 152; it is a development of the familiar "lens-ring" joint used in the Foster

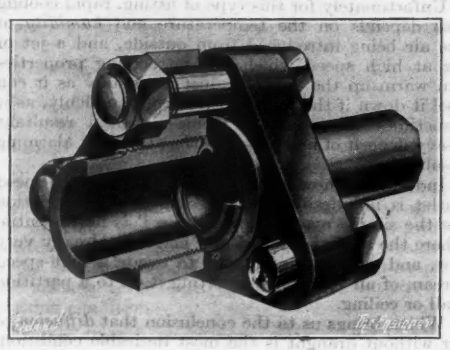


FIG. 152—SELF-SCALING JOINT—GREEN

economiser. The joint is claimed to be self-sealing, by virtue of the elasticity of the crescent-shaped section of the steel joint ring compressed between the conical tube ends. Therefore the higher the internal fluid pressure, the tighter the joint. It is also self-centreing, for an annular rib on the joint ring fits loosely in recesses in the flanges, and the action of bringing the flanges together compels the spherical surfaced ring to assume a central position between the two conical faces of the tubes. Furthermore, the joint is self-aligning. When the joint is made the flanges are butted together, the joint ring being compressed slightly in the process. Relatively broad bearing faces on the flanges ensure proper alignment. A further point is that all expansion and racking stresses are taken by the flange faces and not by the joint faces. We are informed that the joints can be made and remade many times with the same rings and without refacing.

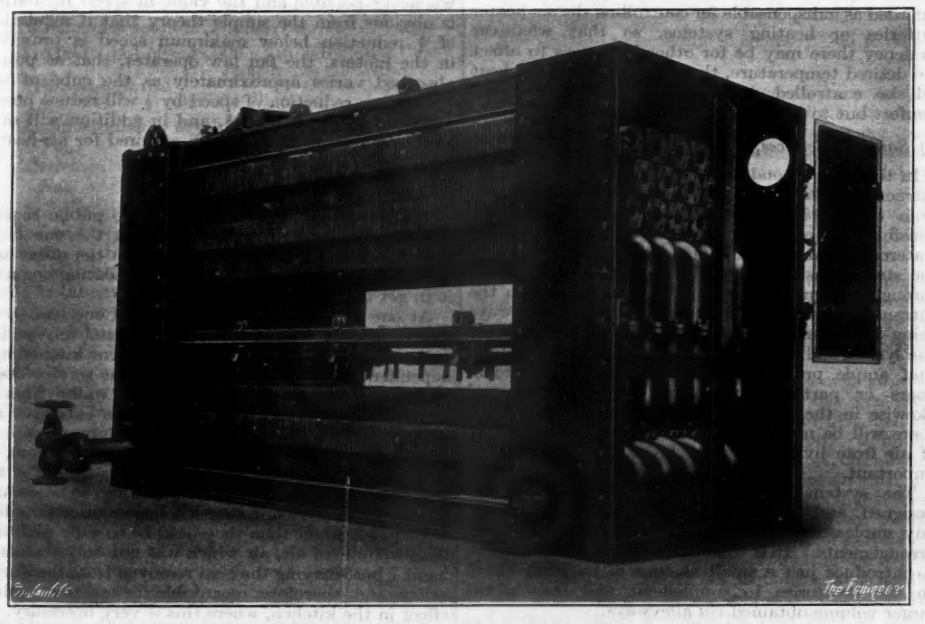


FIG. 151—CAST IRON ECONOMISER WITH SOOT BLOWER—GREEN

From the above description it follows that the points which usually give trouble have been eliminated in this design of economiser. There are no expanded joints, as the stresses in economiser tubes caused by temperature variations make this form of joint unreliable. There are no pressure joints in the gas chamber, and therefore, should a leak develop, it cannot remain undetected and cause wholesale corrosion. There are no lids or plugs to give leakage difficulties, and, in the steel tube design, there are no welds in the gas stream.

After the claims which are made by the firm for the self-cleaning character of the diamond-shaped tubes, soot blowing equipment might be thought to be quite unnecessary. Frequently it is not required, but combustion is not always perfect, and deposits of a smoky or adhesive character may collect on the tubes. For this reason a travelling arrangement of soot blower, which can be seen in Fig. 151, is fitted. It is manually operated and effectively cleans the tubes.

(To be continued)

The Ventilation of Ships*

By R. McDONALD.

The rules that govern the installation of a heating and ventilating system on board ship must of necessity be very different from those we are accustomed to ashore because of the difference structurally. The restriction and congestion too, on board ship is a problem which makes it difficult to reconcile ventilation principles ashore with principles afloat.

The Board of Trade authorities are responsible for the comfort conditions of third-class passengers and crew, but strangely enough where first-class passengers, second class or tourist class are concerned, there are no rules to be enforced as regards heating and ventilation, but it is an unwritten principle that by virtue of their class, these passengers must have nothing inferior to what is laid down by the Board of Trade for third class, steerage, emigrants, or officers, engineers and crew.

It will be observed, therefore, that the basis of requirements for ventilation is that which is stipulated by Board of Trade.

A third-class passenger is allowed a minimum of 15 square feet deck area and 830 cubic feet of air per hour air supply by mechanical means, with an additional 33 per cent. air supply if the accommodation is located in the bowels of the vessel or adjacent to machinery spaces. In actual practice a figure of 1000 cubic feet of air per hour per person is allowed as the minimum for third class and crew, which, relative to the cube of the space occupied by the individual, ensures at least 8 changes of air per hour. As these are minimum requirements and, therefore, represent $\frac{3}{4}$ duty by speed reduction of maximum fan output it follows that in summer conditions when the fans are running at top speed, there will be 12 air changes per hour available or 1500 cubic feet of air per hour per person. Where a vessel is equipped for world tours and must encounter tropical conditions a maximum of 15 air changes is often provided particularly in accommodation below decks which is equivalent to approximately 2000 cubic feet of air per hour per person.

The same air change is given to first class and second and tourist class passenger accommodation, but because a person in this class is allowed more cube or deck area relatively than third class or crew occupy, the quantity of air available for the higher class corresponds to 3000 to 4000 cubic feet per hour per person.

It will be at once obvious that there is a considerable difference between these conditions and those which apply to the requirements for buildings on land, but it has been found from experience that this is unavoidable (*a*) because of the congested nature of things aboardship, and (*b*) because of the necessity for rapid air movement in tropical conditions approaching 100 deg. Fah., where the relative humidity is high and where heat gains are considerable, and where the dissipation of this heat is demanded as quickly as possible to give tolerable comfort to room occupants. It is an argument for air cooling by refrigeration that by its adoption the quantity of air used normally could be greatly reduced and, therefore, save a great deal in the initial cost of ventilating plant; but on the other hand, the cost of refrigerating machinery is a big item and the running cost considerable.

But whatever may be said about air conditioning, whether it will come to stay or not, one thing is certain and that is, that mechanical ventilation is now considered imperative. Shipbuilders and shipowners are gradually realising the importance of it for the success of their vessels. For after all the success of any ship or building depends not upon the beauty of the external appearance but upon the internal comfort, and heating and ventilation of the right kind contribute very largely to the latter.

General Practice

Recent vessels built to operate in all-sea conditions are equipped with separate heating and ventilating systems, and thus approach the more perfect ideal which has been generally realised by heating and ventilating engineers for many years where first-class buildings on land are concerned.

In the most up-to-date vessels the steam-heating system is generally of the vacuum low-pressue type, the pressure of steam not exceeding 5 lb. per square inch and the temperature rise being such that the system will be capable of maintaining a temperature

* Abridged from the Journal of the Institution of Heating and Ventilating Engineers, August, 1939.

of 65 deg. or 70 deg. Fah. as may be desired in passenger rooms, corridors and public rooms. In North Atlantic waters the temperature rise of the air is taken as from zero or minus 10 deg. Fah. and in the Pacific as from 32 deg. Fah.

Insulation

While on the subject of heating it may be advisable to introduce at this stage the all-important question of insulation as a sound investment, and as a preventative against excessive heat losses and the resultant heavy running and maintenance costs. Ship-owners and builders are reluctant to realise the value of insulating the exposed walls and ceilings of living-rooms and public rooms of vessels against excessive heat losses in winter conditions and heat gains in summer and tropical conditions.

It is particularly important to stress the point where winter conditions are concerned, for it is here that the greatest saving would occur. In summer or tropical climates the heat gains are mainly from the passengers themselves and from electric lights and other such apparatus, but it would be undoubtedly well worth while where large public rooms are concerned and where the exposed surfaces are large so that the quantity of air introduced could be at a lower rate of air change per hour than has been found necessary so far. But for a vessel which sails regularly in the bitter cold of Atlantic conditions, there can be no doubt whatever, that insulating the exposed surfaces (on the inside of course) with 2 inch thick non-inflammable cork slabs would be well worth while.

The exposed walls and ceilings of passenger accommodation are formed of an outer skin of steel plating, a 6 to 10 inch dead-air space to the face of the frames or beams as the case may be, and a wood, plaster or composite pannelling of ½ or ¾ inch thickness, the combination of which constitutes the equivalent of an exposed area having a transmission coefficient of approximately 0·5 B.T.U./sq. ft./degree difference/hour. In arriving at this factor allowance has been made for northerly or easterly exposure and wind resistance of high velocity. This high coefficient emphasises that as it approaches twice the coefficient for the 14 inch thick brick wall of a respectable sized building on land, the need for insulation to be applied is very apparent and not to be lightly disregarded.*

The effect of applying 2 inch thick cork to the exposed surfaces of passenger and public-room accommodation would be to reduce the value of the coefficient of transmission to about 0·15 B.T.U./sq. ft. which reduces the factor 3½ times. To carry this still further, it will be at once obvious to the engineer versed in the problem of heating and ventilating that a considerable saving in fuel and running cost must accrue with the adoption of cork or other suitable material as an insulating medium.

Ventilation

To pass from the question of heating to the question of ventilation which is the larger of the two propositions where ships are concerned, it is necessary to sectionalise the systems, which, although entirely independent, are nevertheless co-relative.

(a) Crew Accommodation.

As already explained, crews quarters come under direct supervision of the Board of Trade who have laid down comprehensive rules and regulations for the guidance and observance of the ventilating engineer.

In up-to-date vessels, mechanical extract obtains from the alleyways instead of natural ventilation. It is also usual practice where a mechanical system of fresh-air supply is installed to crews' rooms for two or more fans to be so arranged that it will be possible to link up one system with another so that in the event of one fan failing or being out of commission, an interconnecting duct with an isolating-damper arrangement can be opened up to permit a supply of air under all conditions. The same conditions apply in the case of third-class passengers or emigrants as these also come within Board of Trade ruling.

(b) Passengers' Accommodation.

As a general rule fresh-air supply only is provided direct to passengers rooms by mechanical means on the basis already outlined *i.e.*, at 12 to 15 air changes per hour under maximum operating conditions reducible to 8 to 10 air changes per hour in winter conditions. The maximum amount of air available per person works out at between 3000 and 4000 cubic feet per hour.

Occasionally direct extract from rooms is provided, but this normally applies to special cabins or suites which are isolated from the ordinary alleyways and passages and therefore from the public lavatories. As a general rule the extract from passenger accommodation is of an indirect nature, that is, *via* louvres or gratings in the doors or partitions into the alleyways and removed from thence either direct to atmosphere, but more often by the extract ventilating system obtaining in the lavatories or sanitary services.

Third-class passenger rooms must have separate extract having no connection with lavatory ventilation, and this is often done by large natural ventilators in the rooms or corridors or by mechanical means.

The principle of air distribution in passengers' rooms is carried out either by means of adjustable ball-type high-speed fittings, large regulating gratings, or by air diffusers which are of considerably less area than gratings but admit the same quantity of air.

For many years the ball-type or punkah-louvre fitting was extremely popular as a departure from the ordinary wall-type grating or grille and undoubtedly the fitting has decided merit in that it is small, unobtrusive, and universal in operation, the principle being its capability of admitting large quantities of air at high speed in any desired direction to obtain rapid cooling effect.

Unfortunately for this type of fitting, rapid cooling also depends on the temperature and *humidity* of the air being introduced from outside, and a jet of air at high speed which has no cooling properties can warm up the anatomy just as rapidly as it can cool it down if the temperature drops suddenly, as it sometimes does in the tropics, with a resultant heavy deposit of moisture and the attendant alarming results.

Indeed, it is now being realised that the high-speed outlet is not desirable in passenger accommodation for the simple reason that "throw" is not essential where the space is limited and height is already very low. and where it is difficult to evade a high-speed stream of air except by diverting it on to a partition wall or ceiling.

Which brings us to the conclusion that *diffusion* of air without draught is the most desirable condition, *not concentration*, and that a room can be more satisfactorily cooled by general distribution, not isolated intensity of air flow.

To produce this ideal method of air distribution there are now on the market fittings of British design which allied to a duct system can definitely admit large volumes of air to a room at approximately 1000 to 1200 feet per minute velocity, without draught or discomfort to the room occupants and which produce equable distribution of the air in all directions simultaneously. The design of these fittings is such that they are eminently suitable for incorporating with the electric-light fittings on the walls or ceilings, projecting no more than a few inches, and also readily harmonise by circular, square or rectangular shape, with any scheme of decoration as may be desired. Combined with these fittings there is a device by which if desired directional delivery can be obtained by very simple adjustment.

As already implied, these fittings can admit similar quantities of air to the high-speed fittings, but with different effect, and the same quantity of air as effectively and noiselessly as would be admitted by a grating four times as large.

To obtain and maintain constant desirable temperatures the time must surely come when the value of the thermostatic valve will be appreciated and regarded as indispensable for controlling the air-heater batteries or heating systems, so that whatever tendency there may be for other influences to affect the desired temperature, the source of admitted heat will be controlled decisively, not only to ensure comfort but to effect saving.

(c) Sanitary Services.

In the first, second, or tourist classes the lavatory extract system, although entirely separate in fact from the stateroom ventilation, is indirectly responsible for removing the vitiated air from the staterooms via the louvred doors and partitions of the staterooms into the alleyways and from thence through the gratings or louvred arrangement in the entrance doors to the lavatories, the main alleyways being the intermediate connecting link between the one system and the other. It is imperative, therefore, that ample provision be made both in stateroom doors or partitions adjoining the corridors and likewise in the lavatory doors or partitions, so that there will be no restriction or resistance to the flow of air from living rooms to lavatory. This is very important.

The system is quite successful when correctly designed and safeguards the accommodation from any unpleasantness due to the vicinity of sanitary arrangements. It is sometimes considered advisable to introduce just a small amount of fresh air direct to the lavatories to supplement and freshen the larger volume obtained *via* alleyways.

The success of this system also depends upon the amount of extract obtaining in the lavatories and which, because of the principle described must be at a high rate of air change.

In actual practice, therefore, 20 to 30 air changes per hour extract is the standard set, and to arrive at this basis it is assumed that of the volume of fresh air supplied direct to cabins it is only necessary to remove about 50 per cent. by the lavatory extract system, the other 50 per cent. providing pressure to offset infiltration through portholes, alleyways, staircases, etc. On the principle of so much lavatory and bathroom space in direct proportion to living-rooms, this arrangement works out very well. The inner walls or partitions of lavatories, w.c.'s and bathrooms, are left open at top and bottom so that adequate air movement will take place within the confines of these services.

(d) Public Rooms.

Generally, public rooms aboard ship are given more air than staterooms measured on the basis of air change, because it will be appreciated that less area is allocated per person for seating arrangements than pertains to the passengers' living-rooms. It also follows that if more persons occupy less room there will be a greater amount of casual heat to be dissipated, and this fact combined with the amount of heat gains from electric lights and large surfaces of structure walls make it essential for larger air changes to obtain than applies to passenger rooms.

For this reason also fresh air and extract ventilation is essential, entirely apart and distinct from any other system, and the balanced system of equal fresh air and extract is the usual arrangement with perhaps on regulation a slight excess of fresh air to counteract infiltration and maintain slight pressure outwards.

The rate of air change may be anything from 15 to 20 times per hour depending, of course, on the nature of the public room, whether lounge, reading room, drawing-room, music-room; the location in the vessel; the number of people to be seated, the structural peculiarities whether exposed or sheltered, and so on.

Smoke-rooms, card-rooms and bars are given special treatment in the respect that if the quantity of fresh air required should be determined as 15 air changes per hour, it is advisable to provide extract at the rate of 20 air changes per hour, to combat the tendency for smoke and fumes to escape to surrounding or adjacent public rooms or accommodation.

Where public rooms occur below decks, that is to say in the lower parts of the vessel, it is generally necessary to increase the rate of air change to 25 times per hour, particularly if this refers to a dining saloon as will be dealt with presently.

Distribution and circulation of air in public rooms is of even more importance than in passengers' rooms. In the best ships and in best practice it is endeavoured to arrange the inlets and outlets at ceiling level or on walls in alternative formation so that by the principle of thermosyphonic action, the air will be circulated in numerous sections and not in one large body; thus ensuring equable distribution and stable temperature conditions as far as is practicable.

At this stage it is important to stress the necessity for speed variation on fan motors aboard ship and why it is desirable. There may be anything from 100 to 200 fans on board a vessel aggregating from 200 to 600 or more b.h.p. and it is vitally important that speed regulation should be provided, especially when it is realised that from 50 to 75 per cent. of these motors are running continuously day and night, summer and winter, except when the vessel is in port or laid up for overhaul.

Such enormous power and energy must be curtailed whenever possible and the value of speed regulation is obvious from the simple theory that if regulation of ⅓ reduction below maximum speed is provided in the motors, the fan law operates, that as power absorbed varies approximately as the cube of the speed, so a reduction of speed by ⅓ will reduce power absorbed by more than ⅔, and in addition will save approximately ⅓ of the steam required for air-heater batteries in winter work.

(e) Dining Saloons.

The dining saloon, like other large public rooms, has suffered from over treatment on the one hand and from lack of proper treatment on the other and the problem which confronts the ventilating engineer is to get the right balance.

At one time it was thought that all one had to do was to introduce large volumes of air and rely on the extract system operating in the adjacent kitchen and dependencies to remove the air via the service doors or large gratings in the dividing wall. This is definitely bad practice as it produces excessive air movement in one direction and gives rise to complaints because of draughts and discomfort, in addition to being the wrong method entirely for the successful air movement so desirable and so necessary. Furthermore it meant that kitchen extract fans had to be much larger than they need be to cope with this large volume of air, air which was not only "second-hand" but carrying the heat removed from the dining saloon and, therefore, unsuitable for creating cooling effect in the kitchen, where this is very necessary.

Nowadays in best practice the dining saloon is considered as a separate compartment and ventilated as such but always bearing in mind that there must be some leakage of fresh air towards the kitchen, to prevent odours and fumes from the kitchen entering the saloon. The dining saloon must have its own fresh air and extract plant but the extract is from 25 to 50 per cent. less than the fresh air supplied so that the excess may be available for the kitchen. Ventilated in the ordinary way by mechanical fresh air a dining saloon should have not less than from 20 to 25 air changes per hour in maximum hot-weather conditions and mechanical extract at the rate of from 12 to 18 times per hour.

But it is always desirable to base the air changes upon the particular conditions of the dining room

* As a rule the exposed walls of crews' quarters have no wood or composite lining, and the steel plating is either painted or thinly cork dusted, so that the coefficient of transmission may be as high as 2 B.T.U./per sq. ft./per degree difference per hour for conditions of 5 to 10 deg. Fah. of frost, and 2·5 for North Atlantic or Baltic conditions.

and not upon set air changes. This is where many go wrong, hence the dissatisfaction and the demand for air cooling, because every factor has not been considered in the first instance in determining the quantity to be used.

The following example illustrates the point.

What are the facts which ought to receive consideration but which are very often ignored ?

(*a*) The heat gains from the occupants of the saloon.
(*b*) The heat gains from electric lights grilles and food.
(*c*) The heat gains from the exposed surfaces and walls, and from the machinery casings and kitchen services.

Only by determining the value of these factors in terms of heat can we determine the volume of air necessary to dissipate that heat, if not altogether, to at least a *few degrees above* outside conditions, for it will be appreciated that only an enormous supply of air can keep the conditions within the saloon to the level of outside conditions, and only air cooling by refrigeration can reduce the inside temperature to *below* the outside temperature.

And so the following facts and figures are given to illustrate the absolute necessity for treating the matter seriously and intelligently.

Cube of dining saloon ventilated	= 115,000	
Heat of occupants—500 persons at 400 B.T.U./hr. each ..	= 200,000	
Heat from electric lighting 40 kW at 3400 B.T.U./hour	= 136,000	
Heat from electric grilles 15 kW at 3400 B.T.U./hr.	= 51,000	
Heat from food—500 meals at 50 B.T.U./hr. each	= 25,000	
Heat from structure by transmission and sun effect, approximate only	= 48,000	
Total heat gains	= 460,000	B.T.U./hour

Supposing the maximum air change provided is at the rate of 15 air changes per hour, therefore, the quantity of air delivered to the saloon will be $115{,}000 \times 15 \div 60 = 28{,}750$ cu. ft./min. Thus in the maximum conditions of heat gain in the dining saloon the temperature rise above atmospheric temperature will be

$$\frac{460000}{28750 \times 60 \times 0{\cdot}02} = 13 \text{ deg. Fah. approx.}$$

So that if conditions outside were in the region of 80 deg. Fah. as most commonly obtain in tropical waters, the inside temperature would be about 93 deg. Fah. and therefore intolerable.

To limit the temperature rise within reason, how much more satisfactory it would be to introduce air at 25 air changes per hour, and the result as follows :—

$115{,}000 \times 25 \div 60 = 48{,}000$ c.f.m. circulated.

Temperature rise $\frac{460000}{48000 \times 60 \times 0{\cdot}02} = 8$ deg. Fah.

Assume outside dry-bulb temperature 80 deg. Fah.

Therefore temperature of air within = 88 deg. Fah.

This is a perfectly reasonable condition in the circumstances and represents the state of the air leaving the room, so that with the air entering at 80 deg. Fah. the actual mean temperature in the room would be about 84 deg. Fah. Another point worth mentioning is that whereas the public rooms on topmost decks are generally sheltered from direct sun effect, etc., by promenades and, therefore, can have large opening windows to admit air and natural light, down in the dining saloon there are no such facilities. The sides of the saloon are directly exposed to all weather conditions and temperatures, the portholes or sidelights are much smaller and, therefore, artificial lighting has be greater than for other public rooms.

Electric lighting for dining saloons works out generally at about 5 watts per square foot of ceiling area as against 1½ to 2 watts in other public rooms which makes a big difference in heat gains.

(*f*) *Kitchens and Dependencies.*

Most up-to-date vessels have now electrical cooking apparatus and it is estimated that for a vessel of world-cruising size, cooking equipment between 750 kW and 1000 kW is necessary. Taking into account the electric lighting as a further 10 kW it will be apparent that the heat which could be liberated is staggering.

For the sake of illustration, consider the smaller equipment :—

Total heat from elements and electric lighting = 750 kW + 10 kW	= 760 kW at 3400 B.T.U./hr.
	= 2,600,000 B.T.U./hr.

Of this quantity it is assumed that approximately only ⅔ will be in use at any period and that 50 per cent. of the cookiug load will be dissipated in food which would give us a figure approximately = 875,000 B.T.U./hr.

This enormous quantity of heat set at liberty would result in a very high temperature rise, and if converted into the equivalent in air change in order to remove the heat and equalise the temperature with the outside conditions, would produce an impossible state of affairs in size and capacity of plant. And even to introduce sufficient air to keep the temperature rise to a limit of 10 deg. Fah. above outside conditions would demand somewhere about 100 air changes per hour. In theory this may seem quite easy and practicable, but it is altogether a different proposition when the facts are weighed up ; the low ceilings, the very congested and limited available facilities, and the problem of distribution to avoid excessive draughts and cooling.

In actual practice 60 to 70 air changes per hour extract would work out quite well for the hottest part of the kitchen, reduced to 30 air changes for the dependencies according to their function and position. The amount of fresh air depends upon what is available from the dining saloon and should be made up by a quantity of entirely fresh air introduced direct to the kitchen, &c.

The important thing is to prevent the heat from spreading and if this is arrested at source by suitably-designed ducts and orifices arranged so as to capture the wild heat and fumes direct at the ranges, grilles, toasters, salamanders, steamers, ovens, roasters, fryers, &c., there should be no difficulty about keeping the kitchen services in agreeable and satisfactory working condition.

(*g*) *Cargo Holds and Stores.*

Most large passenger vessels carry general cargo and stores in the holds and 'tween decks, and although some ships have fan ventilation by means of screw-type fans mounted in coamings on deck or below deck, natural ventilation is the usual practice and the standard observed is generally 5 air changes per hour.

(*h*) *Machinery Spaces.*

There are so many sections and compartments allocated to boilers, engines, dynamos, auxiliary machinery, steering gear, bunkers whether coal or oil, and so many different classes of machinery, which all call for special consideration.

In the smaller ships natural inlet and extract ventilators are considered sufficient for requirements with perhaps forced-draught fans for the boilers, but in the larger vessels the fresh-air ventilation is by mechanical means, and large natural ventilators, opening skylights and hoods or dummy funnels act as the extraction ventilation generally.

Air changes vary with the type of machinery but the following gives a general guide for various classes of engine rooms.

For steam reciprocating machinery—20 to 25 air changes per hour.
For turbine machinery—30 to 35 air changes per hour.
For internal combustion machinery—40 to 50 air changes per hour.

There are other important sections in a modern vessel worthy of mention, such as hospitals, laundries, hairdressing saloons, gymnasiums, swimming pool and Turkish baths, which are usually given special consideration in the way of heating and ventilation, and which combine to magnify the difficulties with which the ventilating engineer has to contend.

AIR CONDITIONING

In its most wide interpretation, air conditioning is not simply a reference to the improvement of comfort conditions in summer or the tropics, but in winter also, and it may be that this fact is not fully appreciated.

The air-conditioning installation, however large or small, is quite an expensive item and generally comprises a refrigerating plant, be it of CO_2, methyl chloride, freon or steam ejector type ; complete with compressors, condensers, evaporators, circulating pumps, piping, etc. ; to work in association with the air-conditioning unit with its spray chamber, eliminators and scrubbers, circulating spray pump, water tank, heating batteries and coils, piping, filters ; the fans and motors for circulating the cooled air, and the duct system all insulated, and finally the automatic control system which is most essential and without which it would be utter folly to instal an air-cooling plant.

This briefly describes the installation ; and the function of it, although simple, is worth mentioning in conclusion.

An air-cooling system is installed not primarily to reduce the outside air dry-bulb temperature, but also the relative humidity, which is known to be *the* oppressive element in tropical conditions. For example, in the Red Sea and Gulf of Aden, conditions have been noted by the Meteorological Office to be in the order of 100 deg. Fah. and 80 per cent. relative humidity, and in the Pacific Ocean maximum conditions are about 90 deg. Fah. and 75 per cent. relative humidity ; and, of course, if it is intended that comfort is to be obtained, it will be the duty of a refrigerating plant not only to reduce the inside conditions when the vessel is passing through the Red Sea to, say, 95 deg. Fah. and 65 per cent. relative humidity, but if in the Pacific Ocean to inside conditions of, say, 85 deg. Fah. and 60 per cent. relative humidity.

Although this may represent a large refrigerating plant, usually based on the principle of cooling 25 per cent. fresh air and 75 per cent. recirculated air, it is appreciably much less than the load would be if 100 per cent. fresh air were cooled.

The extraction of moisture from the outside air, or dehumidifying, as it is called, is the function performed by the cooled air contacting with the warmer air, and producing condensation in the conditioner casing. Moisture is thus captured which can be re-used for cooling purposes in such conditions, but in the operation of humidifying in winter time the reverse is the case, water being added to the air by evaporation, thus necessitating a certain "make-up" of water from storage, which would require to be provided for in the vessel.

These are problems which are all involved in air conditioning.

A most important thing to consider is the system of air distribution, when the air has been cooled to be delivered to any room or saloon. Uniform draught-less distribution is much more essential in a system of this kind than with ordinary mechanical ventilation, due to the creating of lower temperatures and humidities ; and unless this is given very careful consideration serious draughts are liable to be caused which would defeat the purpose for which air cooling has come into effect. Strong air movement by the ordinary system when the air is introduced at outside conditions, is not nearly so harmful as a smaller quantity of cooled air not properly distributed, and this is one thing which must be guarded against in the further development and advance of air conditioning in its application to ships.

It is to be hoped that as the study of heating, ventilating and air conditioning becomes more advanced, as applicable to ships, and as real as it is fascinating, so may results be achieved, which will ultimately prove of such benefit to those who live and travel on the high seas that it may no longer be said they do not compare favourably with the comfort conditions to be experienced and enjoyed in high-class buildings on land.

FUEL LUNCHEON CLUB.—At the last meeting of the Fuel Luncheon Club Committee held on October 4th it was unanimously decided that every effort should be made for the carrying on of the Club's activities during the present crisis on the same lines as previously.

HYDROGEN-COOLED HIGH-FREQUENCY GENERATOR.—A 9600 cycle, 500-kW hydrogen-cooled generator with unusual features and characteristics has just been purchased from the Westinghouse Company by Budd Induction Heating, Inc. This high-frequency generator will be used experimentally at the Budd Wheel Company Plant, Detroit, in high-frequency induction heating for internal-surface hardening. Since neither the generator nor the 800 H.P. driving motor requires collector rings, the set is the simplest and most suitable for the use of hydrogen. Internal gas pressure can be relatively high and can vary over a relatively wide range. Heretofore, the use of hydrogen has been limited to large power units such as turbine-driven generators and synchronous condensers. Specifications call for a speed of 3600 r.p.m. and the set to be totally enclosed. The motor will be two pole, of the squirrel-cage, induction type. Designers of the machine are confident that, in addition to reducing noise to a minimum, the increased efficiency will result in defraying the increased cost of hydrogen cooling within approximately two years time.

BATTERSEA POLYTECHNIC DEPARTMENT OF METALLURGY.—The education authorities have recently had the position of technological instruction in South-West London under review, and in their scheme of reorganisation have provided for the transfer of the School of Metallurgy, which has hitherto formed part of the activities of Chelsea Polytechnic, to Battersea Polytechnic. While the accommodation is at present purely of a temporary character, it is hoped, within a reasonably short space of time, to re-house the Department completely in up-to-date laboratories and ancillary rooms to allow of the instruction being given in the best possible conditions with adequate modern equipment. The courses of instruction include in day courses, engineering metallurgy, designed to meet the requirements of engineering students and those engaged in the engineering and metal industries. The instruction, which is chiefly of a physical metallurgy nature, includes lectures and practical work ; metallurgical analysis and assaying, a short course suitable for chemistry students and works analysts ; refresher course in assaying, suitable for metallurgical and mining men ; and in evening courses, general metallurgy, a comprehensive course extending over three years and involving attendance on two or three evenings a week in all branches of the subjects ; engineering metallurgy, designed to meet the requirements of those engaged in the general and/or specialised engineering industry, for those in the metallurgical industry, and for students studying for the national certificates in engineering. The course extends over two years and attendance on two evenings a week is necessary ; industrial metallurgy, this course is suitable for the technical representatives of firms engaged in the production of metallurgical goods, for departmental heads in the light engineering trades, and students. It is essentially a one-year course of lectures. A second year course comprising twelve lectures and twelve practical evenings has been arranged, but attendance at this is optional.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer.

The Pig Iron Market

Active conditions rule in most branches of the pig iron market. The producers are concentrating chiefly upon the production of basic iron for the steelmakers and the output is reaching a very high level. The position is being carefully watched but so far there has been no real shortage of supplies, heavy as are the steelmakers' requirements. There is also a good production of hematite pig iron, large tonnages of which are passing into consumption. The demand for this iron comes also from the foundries owing to a certain stringency in the supplies of low phosphoric foundry iron. There are still good stocks of hematite iron at the producing works, but they no longer weigh upon the makers' hands as was the case earlier in the year. Specifications against contracts are coming forward in this department with increasing freedom and users are obtaining regular supplies. The recent activity in the foundry market has been maintained. More and more of the light castings makers are being put on war work and as a consequence their requirements are steadily increasing. The stocks of high phosphoric iron had accumulated to a considerable tonnage before the war, but encroachments have been made since which have reduced them to more normal proportions. Outputs are maintained at a steady rate and with the gradually increasing demand the position in this section of the market can be regarded as satisfactory. The situation in the market department for low phosphoric iron has become rather tight and it is expected that an Order will shortly be issued bringing this class of iron under control as regards price. There has been a tendency for values to rise, although not to the extent that might have been expected considering the way in which the requirements of the consuming industries have developed. Most of the users of this class of iron are engaged upon Government contracts, and although most of them are obtaining the requisite supplies some have been using hematite as a more easily obtainable substitute for some weeks. A Government Order was issued which became effective on October 10th adding to the Free List imports of pig iron other than that smelted wholly with charcoal and vanadium titanium pig iron produced in an electric furnace. As the two latter descriptions were already upon the Free List the effect of the Order is to remove the duty upon any kind of pig iron. There has been practically no export business done in pig iron since the commencement of the war, and except in special circumstances it is unlikely that any transactions of this kind will be found practicable in the prevailing conditions.

Ironfounders' National Committee

The Ironfounders' National Committee, 21, St. Paul's Square, Birmingham, has addressed a letter to ironfounders making all forms of cast and malleable cast iron, irrespective of whether ironfounding forms the whole or only part of their business, or whether they produce castings for resale or in the form of finished products. The letter states that firms and bodies representing an annual tonnage of 1,800,000 met at York on September 15th with a view to seeing if it were possible to form a war time organisation which would enable the industry to speak with one voice, irrespective of any sectional interests, and also to be a channel through which the Iron and Steel Control could speak to the industry as a whole. It was pointed out that there are approximately 2500 foundries and a variety of Associations in the industry, and that it was a practical impossibility for the Control to contact the industry unless there were a central body. It was agreed to constitute an Ironfounders' National Committee for this purpose and to use the word "Committee" in order to avoid the use of the word "Association." The following Resolutions were passed: "(a) Assistance to H.M. Government—The members present, representing the Cast Iron Industry of Great Britain, unanimously agreed, for the purpose of assisting H.M. Government to obtain its defence requirements, that they would pool their technical and manufacturing resources. The Ironfounders' National Committee had therefore been formed for this purpose. (b) Honorary Officers—It was proposed, seconded, and unanimously agreed that Mr. V. Jobson be elected Chairman. It was proposed, seconded, and unanimously agreed that the Chairman, Mr. P. H. Wilson, Mr. J. K. N. Davis, and Mr. G. W. Allott, with a representative of the heavy industry, to be added later, form an Executive Committee. It was proposed, seconded, and unanimously agreed that Mr. J. G. Pearce be appointed Secretary." The Ironfounders' National Committee is entirely an emergency organisation and is not intended to deal with questions outside those relating to castings. It is emphasised that it is entirely non-sectional. The Executive Committee has met the Controller of Iron and Steel and has been informed that the Control will agree to regard the I.N.C. as representing and acting for the industry as a whole, on the understanding that it should function regardless of individual interests.

The North-East Coast and Yorkshire

Great activity prevails in all departments of the iron and steel markets on the north-east coast. All available plant has been pressed into use and production is upon a record scale. By far the greater part of the output is devoted to satisfying the needs of the priority classes, but a certain amount of production is available for meeting the requirements of the ordinary commercial users. Deliveries are well maintained on the whole, but some delay in the execution of orders has to be reckoned with and few makers care to pledge themselves to definite delivery dates for material for work outside the preference categories. There is a very large output of steel bars which are needed in heavy tonnages by many kinds of users, and there is a particularly strong request for reinforced concrete bars. Great activity prevails at the shipyards on the north-east coast which are taking up enormous quantities of plates. In addition to the shipyards the tank makers, locomotive makers, and constructional engineers are providing a big outlet for this description of steel. The structural engineers who, generally speaking, are well employed are using large tonnages of joists and sections, but for the most part this material is going into use on work directly or indirectly arising from Government contracts, and there has been a decline in the quantities required for other purposes as a considerable amount of public and private work has been suspended since the outbreak of the war. The heavy production of billets by the works on this coast is still not sufficient to meet fully the needs of the re-rollers and their output has been supplemented by large imports from abroad. The scheme for rationing consumers appears to be working satisfactorily, and the re-rolling works are now able to maintain an uninterrupted output of small bars, sections, and strip. In the Yorkshire market active conditions rule and consumers are anxiously pressing orders upon the steelmakers. The latter are working to the programme of preferences introduced by the Control and this means that there is little room for the acceptance of commercial orders. Nevertheless, a certain amount of the latter class of business is being put through, although naturally it has to await the completion of the priority orders. There is an increasing output of soft basic billets at the Sheffield works, but although production is pressed to the limit it is not equal to the full requirements of the consuming industries. The demand for high carbon billets has also reached record tonnages and seems to be growing. There is an extremely vigorous request for special steels and alloy steel, and it is surprising how well the output of these descriptions is maintained.

Scotland and the North

The Scottish iron and steel works have probably never in their history turned out a larger tonnage than at the present time. The production includes all descriptions of iron and steel materials and, large as it is, is passing immediately into consumption. The pressure from consumers anxious to secure delivery shows no signs of relaxing although the great bulk of the manufactured products is for the priority classes. The amount of new business being transacted is comparatively small. This is chiefly because the works have full programmes for the next few months and are reluctant to embarrass themselves with fresh orders. The Control is working in close co-operation with the steelmakers and consumers and has greatly eased the position by careful distribution of the work required for national purposes. Whilst a very high percentage of the present activity is directly and indirectly for the Government it has been found possible to complete a certain number of contracts for commercial consumers. The export demand has declined considerably of late as the panic buying which characterised certain markets on the outbreak of war has subsided. Export licences are now more easily obtainable and the tonnage of work on hand for foreign customers at the outbreak of hostilities is being gradually reduced. Official statements upon the very large programme of merchant shipping under construction are borne out by the activity at the Clyde shipyards, and there is an incessant stream of shipbuilding steel moving in this direction. The constructional engineers, most of whom have big Government contracts in hand, are taking up large supplies of steel in the form of joists, sections, and plates. All the marine engineer boiler makers and locomotive firms are working full time and have sufficient orders on their books to keep them employed until after the end of the year. Activity in the Lancashire iron and steel market is well maintained. The works in this district are operating at capacity and are experiencing great pressure from consumers anxious to secure delivery. The re-rolling industry is as well occupied as the supplies of billets will permit and on this score there has been some improvement of late which, it is understood, will continue during the present month. Business in bright steel bars is at a high level and the production is barely sufficient to meet the demand from consumers. Reports of the purchase of steel in the United States are discredited and it is generally believed that whatever material may be bought abroad in the future, for the time being the Government will rely upon the home production. The demand for special steels is expanding and the requirements of the engineering firms employed upon Government contracts appear to be growing rather than the reverse. On the north-west coast the works are fully employed and have sufficient contracts on their books to keep them busy for some months.

Current Business

An order for twenty locomotive boilers has been placed by the Great Indian Peninsular Railway with the North British Locomotive Company, Ltd., Springburn, Glasgow. This company has also received an order from the Southern Railway for ten locomotive boilers. It is announced by Hattersley (Ormskirk) Ltd., Ormskirk, Lancashire, that as from October 9th owing to further increased costs of production the selling prices of all gunmetal fittings are increased by 10 per cent. and of all cast iron fittings by 5 per cent. Dorman Long and Co., Ltd., are taking steps to reopen their Kiltonthorpe ironstone mine which has been closed for a number of years, and in this event propose to transfer workers there from the Carlin How Mine. After being reopened two years ago the Gordon Colliery, Cowdenbeath, of the Lochgelly Iron and Coal Company, Ltd., is to be closed down, but it is stated that the company hopes to absorb the men thus put out of employment, numbering about one hundred and sixty, at its other pits. The Department of Overseas Trade announces that the following contract is open for tender: South African Railways and Harbours Administration: Supply and delivery of one 20-ton self-propelling, swing jib, steam-driven travelling crane. Local representation is essential (Johannesburg, November 20th).

Copper and Tin

The copper trade continues to suffer from the suspension of dealings on the London Metal Exchange, and until a satisfactory scheme for closing the open positions on the Exchange at the time of the outbreak of war has been accepted by the Government, it is unlikely that the Exchange can re-open. It is understood, however, that proposals put forward by the Committee are likely to be accepted. Even then it will remain to be seen if the authorities will permit the resumption of business. In this country the copper price remains at the official maximum level which has been fixed by the Control, but in the United States and other neutral countries the price of electrolytic copper seems to be still between £65 to £70. It is possible to keep the British price so much below the world price because there were large stocks of copper in the country when war broke out, and the Government has entered into agreements with Empire producers, particularly those in Rhodesia and Canada, by which they have patriotically agreed to sell at prices much lower than the world market. According to a Canadian mining journal the Canadian producers will receive 10¼ cents per lb. This works out at £6 to £7 per ton above the British maximum Control price. No confirmation is obtainable as to the accuracy of this statement, but it tends to uphold the opinion in the trade that eventually a substantial advance will be made in the maximum price in this country. Considerable supplies are also being delivered by the Rhodesian copper companies who seem to have been equally patriotic in their war-time dealings with the British Government. In this country the demand is on a good scale although almost entirely for war purposes. Business in the American copper market continues unusually active, and it is said that some of the manufacturers of copper products there during the past few weeks have booked sufficient orders to keep them busy for the next five or six months. The most interesting event in the tin market last week was the announcement that the International Tin Committee had decided to increase the quota for the third quarter of the year to 120 per cent. of the standard tonnage, this increase to be made retrospective. It was stated that this was done in order to make all the supplies of tin in the producing centres available for consumption. It was also announced that the quota for the fourth quarter would be 70 per cent. It was generally understood that the Committee was guided by the desirability of meeting the extraordinary demand which has sprung up from the United States and other neutral countries and to check the exorbitant rise in prices. According to report, sales in the American market have been made at between £290 and £300 per ton against the fixed Control price in this country of £230. It is generally thought that the increase in supplies resulting from the Tin Committee's decision should tend to stabilise the world market. In this country the demand is strong, but sufficient supplies appear to be available to meet consumers' requirements.

Lead and Spelter

Although no detailed report of the lead trade is possible whilst open dealings are suspended on the London Metal Exchange, the position appears to be fairly satisfactory. Consumers are not complaining of any shortage in supplies although there have been some objections raised at being obliged to use brands to which they are not accustomed. All the stocks of lead in the country are in the hands of the Control and there is, therefore, no trading in the ordinary sense of the word. A very large tonnage of lead must be passing into consumption since all firms manufacturing lead products appear to be working at capacity. In the United States there is a steady demand for lead, and as a result fresh mines which had been closed down owing to the comparative slackness in that market have been reopened. According to the American Bureau of Metal Statistics, the world's production in July amounted to 153,233 short tons. The United States headed the list with 34,926 tons, Australia came next with 24,854 tons. The Canadian output was 16,061 tons, Mexico produced 18,833 tons, and Germany and Austria 17,000 tons. There is an extremely heavy demand for spelter in this country, but the conditions under which trading is conducted are similar to those in the lead market. The ordinary sources of trade are interrupted and there are no free dealings. Consumers have to buy from the Control and are experiencing no difficulty in getting the metal they require; but, as in the case of lead, there has been some complaint regarding the brands which have been delivered and annoyance on this score is to be expected. In neutral markets the price of the metal is well above the British maximum quotation, and the general view seems to be that eventually the Control price will have to be raised. For the present, however, supplies are adequate for all purposes, chiefly on account of the patriotic action of the Empire producers in placing their metal at the disposal of the British Government. In Canada the export of zinc and zinc ores has been prohibited except by special licence.

The Institution of Chemical Engineers.—The Associate Membership Examination of the Institution of Chemical Engineers for 1940 will be held as usual. The closing date for entries will be Wednesday, December 20th, 1939. Copies of past examination papers may be obtained from the offices of the Institution at the price of 1s. per set.

French Engineering Notes

(From our own Correspondent in Paris)

Labour and the War

THE final result of the labour unions' achievement when they obtained, for a time, the forty hours week with the idea of providing more men with employment, coupled with the illusory promise of a more efficient production, led them to accept the principle that cheap production can only be assured with a rational use of machinery which, of itself, gives more work to unskilled hands who are required to aid machine tool operators and handle raw materials through the different stages of manufacture. This attitude towards machinery was intended to strengthen the labour case for a maintenance of the forty hours week. While the short week had to be abandoned the attitude remains, with the result that the one idea of employers and unions is to make up for the deficiency in skilled and specialised hands and provide all the facilities possible for increasing their number. Production under war conditions is accelerated by the absence of labour restrictions and by making the fullest use of skilled hands and of the less skilled who are capable of doing the work allotted to them. There is no protesting against dilution or anything else affecting the right of employers to put whom they please on particular jobs. The unions have nothing to say with respect to working hours and wages which are regulated according to necessities by the State. Wages are based upon the same weekly total for 45 hours as for the previous 40 hours. Under the mobilisation plans arrangements were made to avoid excess profits of any kind on the ground that neither workers nor anyone else had the right to take undue advantage of the screened situation in which they are placed behind those who are fighting at the front. In the case of workers of all classes who are engaged in national and other work for the full week, and even up to 60 hours and more, and who pay the war tax, an additional tax has been imposed on wages for overtime above 45 hours a week. The overtime pay will not exceed the normal hourly rate, and one-quarter of it will be deducted by employers and handed over to the State as a contribution to the national fund for the relief of necessitous families of soldiers under arms. Workers are regarded as a privileged class so far as their material situation is concerned, and they must contribute out of what they receive above the normal weekly pay in aid of dependents on those men who have been called away from their jobs.

Paris Transports

The evacuation of, probably, more than one-half of the resident population of Paris has greatly facilitated the reorganisation of the public transport systems which had to be adapted abruptly to a shortage of so large a proportion of men and members of administrative staffs. On the Metropolitan railway the two half-circular lines that join at the Etoile and La Nation have been closed as well as several lines connecting up the transversal system, which, in some cases, is running with a fewer number of stations open to the public. On the closed section fifteen stations have been converted into air raid shelters. These are mainly in the northern and north-eastern parts of Paris where the underground is usually at a good depth, and there are half a dozen other stations on the lines in operation which are similarly available for shelter in case of need. The supply of current for traction on the Metropolitan is automatically cut off by an air raid signal. Notwithstanding the big reduction in the mileage of lines in operation and the closing of many stations, which are being gradually re-opened, the service is quite satisfactory in co-operation with the omnibuses. Omnibuses had for a long time been withdrawing from direct competition with the Metropolitan, and a large number of lines had been suppressed for reasons of economy, and now the situation is, to some extent, reversed, for omnibuses have a monopoly of large areas temporarily abandoned by the Metropolitan and they are indispensable over routes where a number of underground stations are closed. A marked feature of these changed conditions is the revived popularity of the omnibus, which is giving efficient service, and it suggests that if the underground and surface transport facilities had originally been arranged to be complementary to each other instead of competitive they would not be in a perpetual state of financial deficit.

West African Ports

The pressure on the country's resources at the present time is not likely to interfere seriously with the carrying out of harbour extensions on the west coast of Africa where naval necessities are taken into account as well as the commercial. While in only one case is there any intention to provide accommodation for ships of war, the possible utility of other ports for the navy is not overlooked. On the west African coast there is no natural refuge for ships, for the whole of it is sandy and shelving and is liable to heavy silt, but remarkable works are already well advanced, notably at Casablanca, where an extensive harbour is constructed with concrete wharves and sea walls. There are plans for the construction of an outer port which will accommodate the largest ships in the French navy. The valuable phosphate trade provides adequate resources for the construction and equipment of docks, and extensions and improvements are constantly in progress, while the completion of the outer port, partly at the expense of the French Government, will give to Casablanca some real naval utility. The harbour at Dakar was extended as a basis for air traffic across the South Atlantic, and little has been done, so far, to give it any military value, which would necessarily be limited. Pointe-Noire is another harbour that has arisen out of very unpromising surroundings. It is the terminus of the line from Brazzaville on the Congo river, and the harbour was officially opened in April last, though it is far from completed, but its proved commercial value implies that it may be greatly extended and, perhaps, offer some service to the navy. Work on these ports cannot be suspended in view of the necessity of intensifying the commercial traffic and providing for some useful protection to ships on one of the main sea routes.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

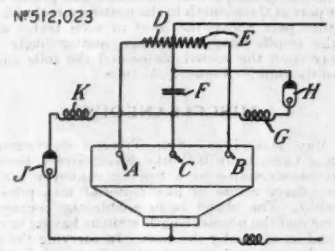
Copies of Specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSFORMERS AND CONVERTERS

512,023. February 22nd, 1938.—COMMUTATION OF CURRENT IN A CONVERTING ARRANGEMENT EMPLOYING A DISCHARGE DEVICE, Allmänna Svenska Elektriska Aktiebolaget, of Västerås, Sweden.

It is known that a forced commutation of current in a converting arrangement employing a discharge device can be obtained by connecting between the active anode and the anode next in turn to be active a source of voltage which raises the potential of the latter anode above that of the former, and it is also known to employ a condenser as such a source of voltage. The current to be furnished to the anodes by this condenser varies substantially proportionally to the load of the rectifier or other converter, and if no special steps are taken for an equalisation, the voltage of the condenser will therefore also vary substantially in proportion to this load. This is, as a rule, not desirable, and means have therefore been proposed and described for additionally discharging the commutating condenser in the cases of low load. The present invention refers to means of the last-mentioned kind. According to one arrangement described in the specification the commutation is effected by means of so-called transition anodes. A current converter has two main

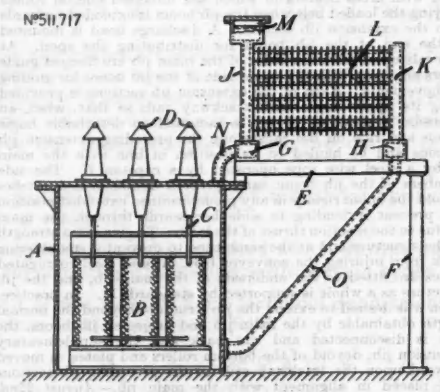


anodes A, B, one transition anode C, and a single-phase transformer, the winding parts of which are designated by D and E. The condenser F for feeding the transition anode has a second discharging circuit containing an inductance G and a separate valve path H blocking it after discharge. Whether the valve H s released simultaneously with the transition anode, or with a fixed or load-dependent retardation with respect thereto, an investigation shows that the time-integral of current flowing through the valve H increases as the current through the transition anode decreases and so the period available for commutation is kept sensibly constant. The subsequent charging of the condenser is effected, after the transition anode has been blocked, by releasing a valve J, which connects its lower terminal over an inductance K to the cathode which has a positive potential with respect to the transformer neutral. With the same connection as illustrated this converter is particularly suitable for operating with a voltage regulated down to a very low value, for instance as a phase compensator on an A.C. network with the D.C. side short-circuited, but if the anode of the valve path J is connected to a point having another potential, for instance, produced by means of an auxiliary rectifier, this form may operate satisfactorily at any D.C. voltage.—*August 28th*, 1939.

ELECTRICAL APPLIANCES

511,717. April 14th, 1938.—COOLING OIL-FILLED CONTAINERS FOR ELECTRICAL APPARATUS, Asea Electric, Limited, of Fulbourne Road, Walthamstow, E.17, and Alf Schaanning, of Skogen, Forest Way, Woodford Green, Essex.

This invention relates to means for cooling oil-filled containers for electrical apparatus, such as transformers. A is the transformer container filled with oil, within which the windings B of the transformer are arranged, the windings being connected by means of insulated conductor C to the terminals D arranged on the top of the container. At the side of the container A there is arranged a shelf E, one side of which rests upon the

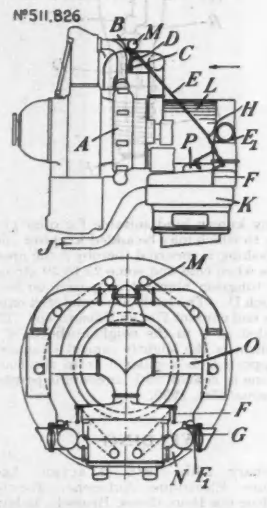


top of the container A, and the opposite side of which is supported by means of legs F. The shelf is arranged above the level of the top of the container but not directly over it. Suitably mounted on the shelf E are arranged a pair of horizontal headers G, H, to each of which is connected a series of vertical headers J and K respectively. Between the series of vertical headers J and K there is a number of gilled tubes L. At the upper ends of the series of vertical headers J there is provided an expansion chamber M. The horizontal header G is connected by means of the pipe N to the cover of the container A, and the horizontal header H to the lower portion of the container A by means of the pipe O. When the oil becomes warmed it passes from the upper portion of the container through the pipe N in the container cover to the header G, whence it flows upwardly through the vertical headers J and then through the gilled tubes L where it is cooled. The cooled oil passes from the tubes L to the headers K, into the horizontal header H and back to the lower portion of the container through the pipe O. In this manner a continuous circulation of oil takes place and the oil is cooled more efficiently owing to the fact that any heat rising from the sides or cover of the container does not come into contact with the gilled tubes and thus tend to nullify their action.—*August 23rd*, 1939.

AERONAUTICS

511,826. December 30th, 1938.—REGULATING DEVICES FOR AIRCRAFT ENGINES, Bayerische Motoren Werke Aktiengesellschaft, Lerchenauerstrasse 76, Munchen 13, Germany.

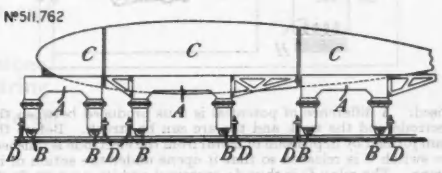
With a set of exhaust gas turbo blowers for charging an aircraft engine it is well known that the output of the exhaust gas turbine rises the more, the lower the counter pressure of the atmosphere with the increasing height of flight, as in this manner the useful pressure drop becomes greater. For more effectively utilising an exhaust gas turbine, as is the case at considerable heights of flight, it has already been proposed to include the exhaust gas turbine only after a considerable height of flight has been reached and up to this height of flight to compress the charging air for the engines by means of a charging blower driven mechanically from the crank shaft of the engine. The invention is based on an arrangement wherein there is provided a charging blower driven by an exhaust gas turbine and a charging blower driven mechanically from the crank shaft of the engine, and the object of the invention is to provide an automatic regulation of the two ranges of the charging pressure. The ground level charging blower A is constantly driven by the engine. Anterior to this blower is the charging air throttle flap B which is actuated through the lever C from a charging pressure regulator, not shown, and/or by the pilot's regulating



lever. Through the lever D, which is guided in an elongated hole in the lost motion rod E and the second lost motion rod E_1 which engages with the lever F by an elongated hole, the actuating lever F and F_1 of the exhaust gas throttle G is connected to the charging air throttle as shown in Fig. 2. This mechanism is duplicated for connecting the throttle B to the second throttle G. The rods E and E_1 are hinged at their adjacent ends to a rocking lever H which serves to guide them during their movement. As long as the exhaust gas throttle G is open and the exhaust gases pass out into the atmosphere, the ground level charging blower sucks the air through the pipe J and the turbo blower K and the coolers L. When the exhaust gas throttle is closed gradually, the exhaust gases no longer pass from the exhaust gas collecting ring M into the atmosphere but flow through the pipe N and also into the turbine. The air is thus pre-compressed by the turbo blower and is supplied through the pipes O and the coolers to the ground level charging blower. The speed limiting regulator P for the exhaust gas turbo blower K engages through rods with the hinge point of the lost motion rod E_1 and shortens the rod for disengaging the turbine when it exceeds the maximum speed, as it collapses it through the joint whereby the exhaust gas throttle G is opened and a further impinging of the exhaust on the turbine is avoided.—*August 24th*, 1939.

511,762. March 20th, 1939.—CONSTRUCTION OR ERECTION OF LARGE BODIES, SUCH AS AIRCRAFT PARTS, Junkers Flugzeug- und-Motorenwerke Aktiengesellschaft, 39 Junkerstrasse, Dessau, Anhalt, Germany.

In constructing comparatively large bodies such as the fuselages, wings, or like parts of aircraft which are made up from separate component parts it is customary to employ a single device which serves to support the body concerned during erection. If such a device is made transportable special advantages are afforded, but in view of the large size of the device and part moving them from place to place is difficult and cumbrous. Moreover, during such changes of position large erecting devices often suffer distortion as the result of which the still unfinished and therefore non-rigid parts mounted in the erecting device are liable to undergo undesirable changes of shape or position.



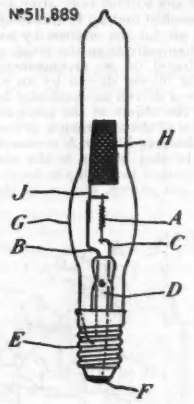
According to the invention these drawbacks are obviated by sub-dividing bodies to be constructed and constructing the several component parts in separate erecting devices, the latter being brought, when the components are completed, into such a relative position that the components they carry can be assembled to form the single large body. As shown in the drawing devices A provided with rollers B for erecting the components are arranged in series to run on the rail track on the ground. Each of the devices serves for erecting one of the component parts C of the body, such as a large aircraft fuselage, to be constructed. When these component parts are completed their erecting devices are run along the track so as to bring the components into their final relative position for assembling to one another. Since the rail track is not as a rule sufficiently accurate for the assembling of the component parts carried on the erecting devices, and which are still not perfectly stable

rigid members, the erecting devices are provided with vertically adjustable supports D which enable the component parts to be accurately adjusted in relation to a fixed plane of reference during construction and also in relation to each other when being assembled together.—*August 23rd*, 1939.

LIGHTING AND HEATING

511,889. September 2nd, 1938.—Gas-filled Electric Incandescent Lamps, *The General Electric Company, Limited, of Magnet House, Kingsway, London, W.C.2.*

This invention relates to gas-filled electric incandescent lamps and more especially to those filled to a pressure exceeding atmospheric and operating with the filament at a temperature exceeding 2700 deg. Cent. Such lamps have usually a short life because the envelope and subsidiary metal elements of the lamp run so hot that oxidising gases are liberated which attack the filament. The object of this invention is to mitigate the effect of such liberation. In the illustration, the tubular vitreous envelope (which may be of quartz, if the pinch shown is replaced

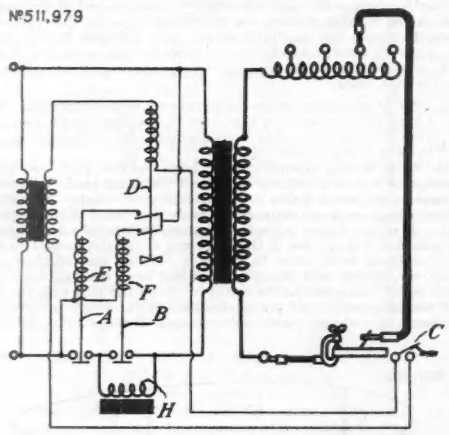


by a seal of any known kind suitable for quartz) is filled with argon-nitrogen to which may be added krypton and/or xenon, if no danger of flashing is incurred thereby; the pressure is about 10 atmospheres when cold and some 25 to 30 atmospheres when hot. A is the tungsten filament supported on leads B, C sealed through the pinch D. The leads are connected externally to the body E and the end contact F of an Edison cap. The envelope is slightly expanded at G in the neighbourhood of the filament. Above the filament is the slightly conical chimney H of nickel wire gauze supported on a pillar J from the lead B. The interior of the cone is coated with zirconium powder sintered to the nickel.—*August 25th*, 1939.

WELDING

511,979. February 28th, 1938.—Electric Arc Welding La Soudure Electrique Autogene, Societe Anonyme of 58–62, Rue des Deux Gares, Brussels, Belgium.

The installation in accordance with the invention comprises a welding transformer, the primary winding of which has two switches arranged in series with it and with each other. During normal operation, these two switches are closed but means are provided for opening the two switches one after the other so that an impedance, which during normal operation is short circuited by one of the switches, is put in the primary circuit for a few seconds before the welding current is cut off. With such an arrangement, the current can be reduced before it is finally cut off and the amount by which it is so reduced is independent of the diameter and of the nature of the electrode used. The arrangement operates as follows: It is assumed that the switches A and B are open. To strike the arc, the electrode is first of all placed at the exact spot where it is desired to start the welding. The welder then closes the switch C. The time relay D is thus energised so that a circuit is made for the electromagnets E and F and the switches A and B are

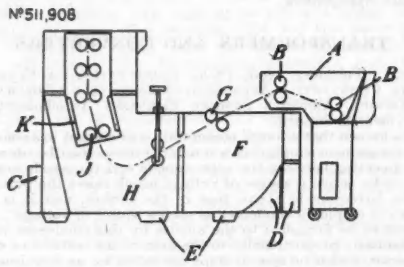


closed. A difference of potential is thus produced between the electrode and the work and the arc can be struck. Before the seam formed by deposition of metal from the electrode is finished, the switch C is released so that it opens under the action of its spring. The relay D is thus de-energised and its contact finger is immediately actuated so that the switch B opens and puts the induction coil H automatically into the primary circuit of the transformer. The welding current is thus reduced by the impedance of the coil. The relay D has an adjustable clockwork mechanism which delays the movement of the finger for some seconds so that the electromagnet E of the switch A remains energised for a certain time before causing the switch A to open and open the primary circuit of the transformer. The amount by which the current is reduced depends only upon the impedance of the induction coil H. The latter can, therefore, be the same irrespectively of the kind or size of electrode used. The time during which the reduced current is to flow in order to obtain the desired effect is only a few seconds. The described arrangement is economical in that the transformer is not connected to the source of current during idle periods. The no-load losses of the transformer are thus eliminated.—*February 28th*, 1939.

METALLURGY

511,908. November 17th, 1938.—Apparatus for Manufacturing Tin Plates, Evan Evans, 9, Hafod Street, Port Talbot, South Wales.

In the apparatus described the plates to be treated pass through a washing compartment or water tank A in which are fitted two pairs of rollers B through which the plates pass. The water tank may have at its lower part a grate to heat the water. From the water tank the sheets pass to the main part of the apparatus, where the coating takes place, which is constructed as a double pot. This double pot is shown having at the end away from the water tank a furnace C from which the combustion gases are led through flues D. Cold-air passages E are provided at the lower part of the apparatus for cooling

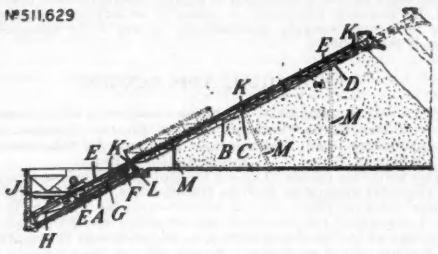


the rolls by keeping the pots cool, in the coating tank of the apparatus through which the plates are passed. The plates from the water tank enter the coating tank F, pass through rolls G therein, through a passage in a dividing wall and then through rolls H, the latter rolls being adjustable, and finally pass through one or more pairs of rolls J arranged in a frame, the lower end of which is advantageously set at an incline to the vertical so that the sheets enter the rolls without difficulty. On the sides of the lower part of the frame are plates K, which depend for part of their length in the coating metal and protrude for the other part above the level of such metal and serve to keep the scruff, dirt, and foreign matter likely to cause stains, away from the coated plates and the rolls guiding the plates from the tank.—*August 25th*, 1939.

MISCELLANEOUS

511,629. May 21st, 1938.—Soil Tipping Conveyors, John Skelding Lane, Lanwill Works, Silver Street, Brierley Hill.

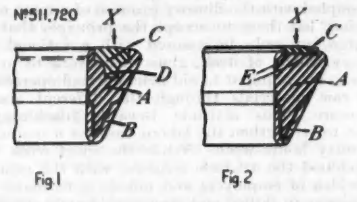
This invention relates to a tipping conveyor for stacking colliery or quarry refuse or like material into piles to form storage banks. The object is to enable the conveyor to be extended beyond the normal length without having to dismantle the head end as is usually the case. In carrying the invention into effect, the conveyor consists generally of a tail belt-storage section A, a main jib B, a telescopic jib boom C within the jib, and an extension jib section or sections D. In the tail belt-storage section is a conveyor belt E which, after passing over a floating tension drum and driving drum, is deflected by a roller and passes upwards to the top side of a storage belt drum F rotating in longitudinally slidable block bearings in a guide rail G. After passing over the belt drum, the conveyor belt passes rearwards to a floating tail drum H rotating in a loaded bogie running in guides in the frame of the tail belt-storage section whereby the tail drum can be moved rearwards. After passing over the tail drum, the belt passes beneath a chute J fed from a hopper. By this means, the length of the belt is doubled in the belt-storage section relatively to the length required to be payed out to allow for the extending action of the jib. The forward run of the belt is supported by transversely troughed idler rollers at close intervals upon bearers fixed in the upper part of the main jib. The return side of the belt is supported by horizontal rollers or idlers. The belt-storage section, main jib, and extension jib section are connected by pivot pins K so that these members can be raised or lowered through an



arc of plus or minus 5 degrees. Within the main jib is the telescopic jib boom which is formed of channel side members fitted with cross bearers in which are mounted end-on rollers carrying the loaded belt when the jib boom is extended forwards from the extension jib section. A discharge head is mounted on the end of the jib boom for distributing the spoil. At intervals upon the inner sides of the main jib are flanged guide rollers engaging with the upper side of the jib boom for guiding its movements. Each of the extension jib sections is provided along its upper edges with trackway rails so that, when an extension is required, it can be mounted on detachable bogie wheels and ride on the rails along the preceding extension jib sections and be hauled to its position in line with the main jig by a steel wire rope operated by a capstan L. The side members of the jib boom carry pivoted double-armed catches to hold the boom rigidly in any predetermined extended position and prevent it tending to slide backwards through the main jib due to the reaction thrust of the load. To give extra strength to the structure and at the same time to prevent a smouldering bank from injuring the conveyor belt, pressed steel corrugated plates are fitted to the underside of the main jib, and the jib structure as a whole is supported by standards M. In practice, when it is desired to extend the jib structure beyond the normal length obtainable by the main jib and projected jib boom, the belt is disconnected and run back and the supplementary extension jib, devoid of the bottom rollers and plates, is moved forward upon the trackway rails of the preceding jib sections and placed in alignment with the main jib.—*August 22nd*, 1939.

511,720. May 12th, 1938.—Joint-making Material, The Stanton Ironworks Company, Limited, Stanton-by-Dale, Nottingham, and Percy Hutchinson Wilson, of the Company's address.

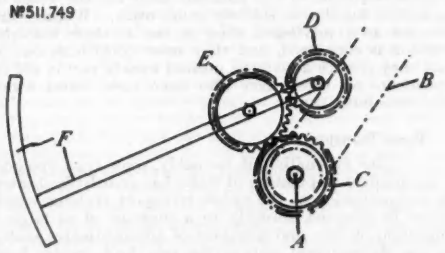
In certain forms of pipe joints it is usual for the gland ring to be rotated into the final position, and when the joint ring, as commonly used, is of a resiliently deformable material such as rubber, the friction between it and the gland ring, notwithstanding lubrication, remains substantial, so that the joint ring during tightening has a tendency to be circumferentially deformed, with a risk of its creeping after the joint has been made, and reducing the effectiveness of the seal between the pipes. The invention consists in a method of manufacturing a joint ring according to which an element of a harder material is united with a resiliently deformable body portion of rubber in the process of moulding, in such a way as to be exposed to engagement by the gland ring when assembled therewith. Convenient constructions of joint rings, according to this invention and as shown in the drawing, comprise essentially a tough vulcanised rubber or like body A of substantially wedge section for entry thin end first into the space between spigot and socket surfaces. The thin end is reinforced at B with canvas or, if desired, tipped with lead or other soft metal. The base, to be engaged in the direction of the arrow X by the gland ring,



has embedded in it a ring or washer element C of harder fibre-filled or reinforced "plastic" or synthetic moulding composition, which is exposed and may protrude, as in Fig. 2, a short distance from the rubber base and at this region (or right through) is treated or impregnated with graphite or other lubricant whereby it is self-lubricating where the gland ring engages it. The joint ring body as a whole contracts in diameter in being forced home into the socket, and to permit the hard ring C to follow this contraction it is formed not as a continuous ring but in any suitable number of segments, separated circumferentially by a sufficient amount. Sawcuts through the harder material, either radial or oblique, may suffice for the purpose; but on the other hand and with the same effect the ring may be built up initially with separated segments.—*August 23rd*, 1939.

511,749. January 3rd, 1939.—Improved Driving Arrangement for use with Conveyors, Elevators, and the like Machines, James Forsythe Cherry, "The Anchorage," Clonskeagh Road, Dublin, S.4.

One example of the invention is described in the accompanying drawing which shows the lower part of an elevating conveyor. A sprocket or chain wheel shaft A carries the return wheel for the chain and is slidably mounted in bearings (not shown) so as to be capable of being moved upwards or downwards at the same angle as that of the carrying chain B with the object of enabling the chain to be tensioned. The lower return wheel is associated with driving mechaniam for the conveyor, and to this



end a gear wheel C being mounted on the sprocket shaft. This gear wheel, despite its adjustability, can be constantly driven by a driving gear wheel D by virtue of an intermediate gear wheel E which is mounted on a quadrant arm F movably connected with a suitable part of the framework of the machine. The quadrant arm pivots at the shaft of the gear wheel D so that irrespective of the position of the arm the intermediate gear wheel will remain constantly in mesh with the wheel. Further by manually acting upon the arm F the wheel E can be made to follow the movements of the wheel C and maintained in mesh therewith. The result is that the return wheel can be positively driven at all times.—*August 23rd*, 1939.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Institution of Electrical Engineers

Saturday, Oct. 21st.—N. Midland Centre. Hotel Metropole, Leeds. Chairman's Address, W. Dundas. 2 p.m.

Monday, Oct. 23rd.—S. Midland Students' Section. James Watt Memorial Institute, Great Charles Street, Birmingham. "Distribution Systems," H. J. Sheppard. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, Oct. 24th.—39, Elmbank Crescent, Glasgow. Presidential Address, W. Ayre. 6.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Oct. 27th.—Mining Institute, Newcastle-upon-Tyne. "Rolling of Ships under Way: The Decrement of Roll due to Hull and Bilge Keels," G. S. Baker. 5.30 p.m.

North of England Institute of Mining and Mechanical Engineers

Saturday, Oct. 21st.—Neville Hall, Newcastle-upon-Tyne. General Meeting. 2.30 p.m.

Iron and Steel Institute

Thursday, Nov. 23rd.—4, Grosvenor Gardens, S.W.1. Statutory Autumn Meeting. 3.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS

Dr. J. H. Paterson, D.Sc., F.I.C., has resigned his post as Managing Director of the Murex Welding Process, Ltd., and has joined the Arc Manufacturing Co., Ltd., "Actarc" Works, Goldhawk Road, London, W.12, as Managing Director.

John Bruce and Staff, Consulting Engineers, late of Windsor House, Victoria Street, S.W.1, have moved, for the duration of hostilities, to 40–41, Worcester Place, Swansea. Tel. No. Swansea 3527. (Top Floor of Electricity Dept. Showroom Building.) Mr. Bruce's temporary private residence is "Glyn-y-Coed," 110, Newton Road, Mumbles, Swansea.

The Phosphor Bronze Company, Ltd., Birmingham and London, announces that at a Board Meeting recently held, various changes were put into effect, resulting in a modified constitution of the Board of this Company, as follows:—Mr. E. J. Hardy, Chairman; Mr. J. L. Hardy, Joint Managing Director; Mr. W. Smithson, Joint Managing Director and Sales Manager; Mr. G. T. Hyslop, Director, Production Manager, and Sole Purchasing Agent; Mr. E. H. Powis, Director; Mr. W. E. Sparrow, Director; Mr. F. R. Wix, Director.